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THE TWIN-WIRE APPLIANCE

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WHEN I received your chairman's invitation to appear before your Society with a paper on the twin-wire appliance my first impulse was to decline it. I realized that since presenting this subject before the Chicago Centennial Dental Congress, in 1933, the technique of working the appliance has been changed very little or not at all. After some thought, however, I decided that maybe I could prepare another paper and in it try to emphasize certain parts of the technique which are so important in working the appliance and to go into greater detail regarding the making of the twin-wire alignment arch. Furthermore I decided to show, in connection with my paper, a Movie which I hope will illustrate the ease with which the appliance can be made and worked.

Let me refresh your memory by going into some detail as to how the twin-wire arch is constructed. You will recall it is composed of two tubes into which a double-fine stainless steel wire is drawn.

In Fig. 1 is shown the tube and the different steps employed in soldering a hook to it. I call these the end tubes to differentiate them from the tubes attached to the molar bands. The end tube is made of stainless steel; the outside diameter is 0.036 inch, and the inner diameter is 0.016 inch. A gold platinum hook is soldered to this tubing when intermaxillary rubbers are to be used. The Krupp technique is employed in soldering this hook to the tube. I use a high karat solder and am careful to flow it completely around the tubing.

The hard stainless steel wire 0.010 inch in diameter is doubled on itself and passed through the end tubes, as shown in Fig. 2. The loose ends are crimped with a special plier made for that purpose, as shown in *F* in Fig. 2.

Read before the Chicago Dental Society, February 16, 1937, and before the American Dental Association, Atlantic City, July 14, 1937.

The arch is now placed into a vise, Fig. 3. This is an ordinary hardware store vise. It has two sets of 0.036 inch slots cut in the jaws. These grooves are not cut completely across the vise but there is a stop at $\frac{1}{16}$ of an inch from the inner surface. A jeweler's saw 0.010 inch wide is used to cut the slots the

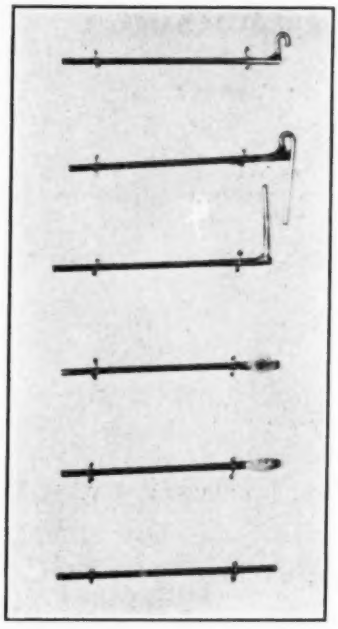

Fig. 1.

Fig. 2.

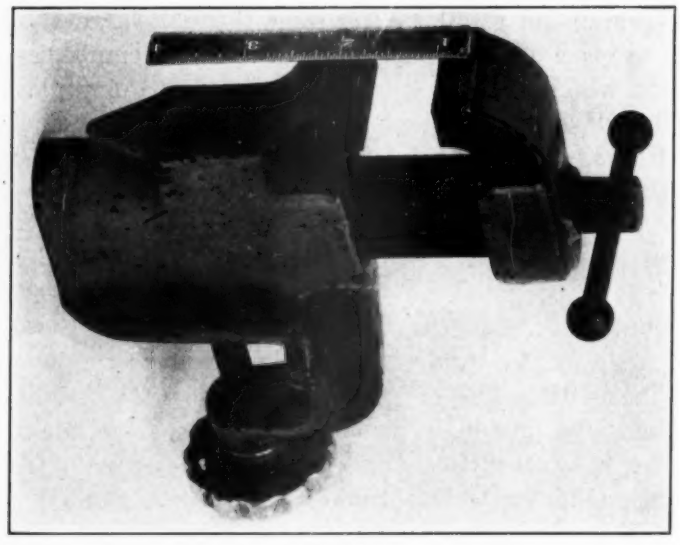

Fig. 3.

rest of the way. These slots let the fine wires pass through and form a shoulder against which the ends of the tubes rest and prevent them from sliding through; then the wire is drawn into the tubing by opening the jaws of the vise. Since the looped end slides into the end tubing easier than the crimped end, a wire is passed through the loop which prevents it from being

drawn in, until the crimped end has been drawn into the tube to the desired distance, which is usually about ½ inch. Then the wire is removed from the loop, and this end is also drawn into the tubing until the correct size arch is formed.

Since the tubings are made a uniform length, it is the midsections that are drawn to different sizes. These sizes range from 1⅜ inches to 3 inches, having a difference of ⅛ inch in each size arch. This is the standard form of arch, but, of course, any variation desired in the lengths of tubes and midsection

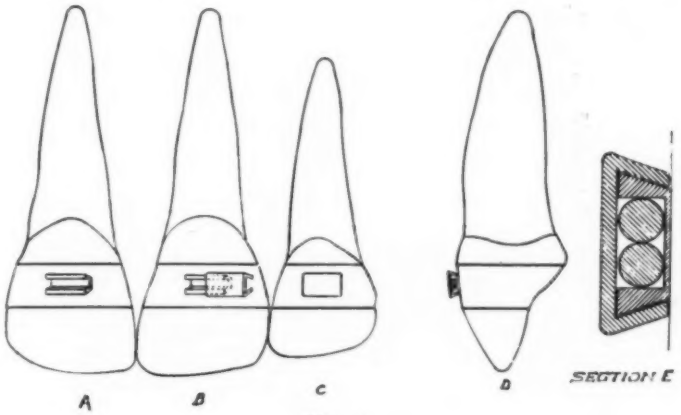

Fig. 4.

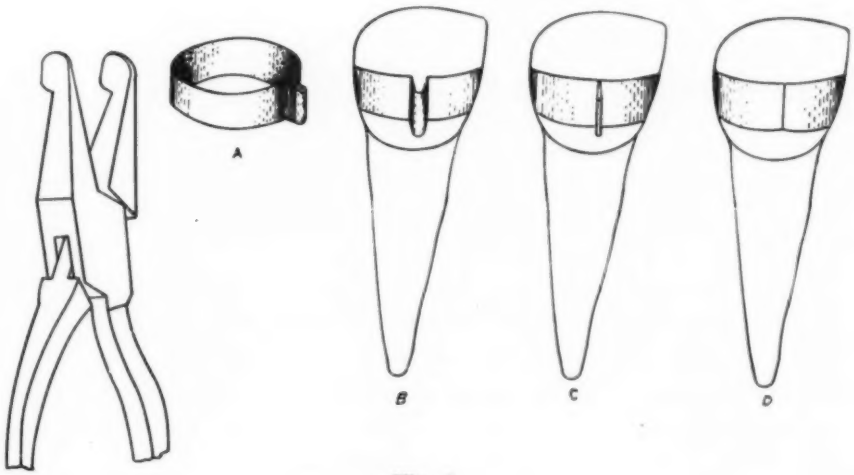

Fig. 5.

may be constructed in the same way. On slack days I make a number of these arches and thus always keep a good supply on hand.

This type of arch does not work properly if ligated to the teeth with wire or grass ligatures; this is especially true in the maxillary arch. In the mandibular arch, when only minor tooth movement is necessary, it works very well with wire or grass ligatures. The ligature should be placed so that the ends can be bent into the interproximal spaces, so as not to scratch the lip.

For the benefit of those who have not seen the locking device used to hold the arch in position I shall give a brief description of it. It is composed of

a male and female part, the former is welded in the middle of and parallel to the edges of the band, Fig. 4. It has parallel walls forming a channel in which the twin-wires are to be seated. The outside wall is dovetailed. The female part, which for the sake of clearness I call a cap, slips over it and fits closely and is held in place by friction. The locks are ⅛ inch long, 1/16 inch wide and 1/32 inch thick. They are supplied welded to bands similar to my loop molar bands, Fig. 5. The loop provides quick and accurate fitting. With the three standard sizes, any anterior or premolar tooth can be fitted. This eliminates carrying a large assortment in stock.

A much easier and better way of drawing the bands around the anterior teeth, however, is shown in Fig. 6. It is so simple that it is almost as easy to make a band as it is to tie a wire ligature around the tooth.

This is the method: Instead of the loop band, I am now using a seamless band which is held on the tooth at the correct position; then, with a modified dam-clamp forceps, the band is stretched tightly around the tooth. The tech-

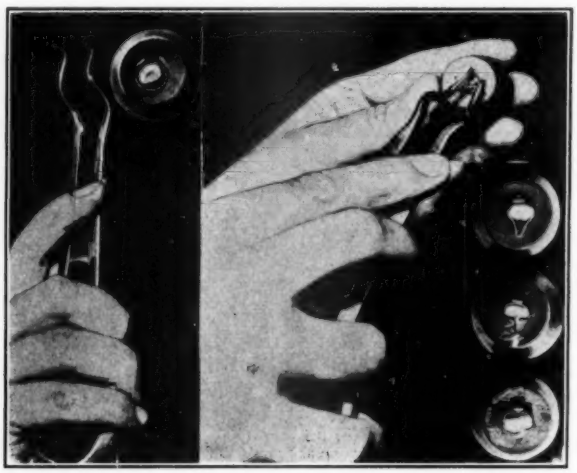

Fig. 6.

nique, shown in Fig. 6, is briefly this: The beaks of the forceps are slipped between the lingual surface of the tooth and the band; the handles are compressed, which opens the beaks and stretches the band tightly around the tooth and at the same time forms a loop on the lingual surface. With Howe pliers this loop is pinched together. The band is then removed, soldered, trimmed, and a well-fitting band is ready to be cemented on the tooth.

These bands are made in three sizes and two widths, that is in ⅛ and 3/32 inch. I have been using the narrow bands entirely during the past four years. They have the following advantages over the wider bands: First, they are more esthetic. It is surprising how much difference 1/32 inch makes in the appearance of a band. Second, they conform more readily to the contour of the tooth; which makes them easier to fit Third, they do not interfere with the contact point. Fourth, when it is time to recement them, they are readily removed without tearing; and if they are properly fitted, I have no trouble with them coming off.

If the bands are correctly fitted, the locks are at right angles to the long axis of the tooth and should be placed on it so that when the teeth are moved to their correct position, the locks will all lie in the same plane.

Two pliers *D* and *E*, Fig. 7, are used to seat the twin wires. The *E* pliers, called placing pliers, is used to pick up the cap or female part and start it over the male, *C*, Fig. 7. It is furnished with a stop which permits a slight tightening of the cap. The *D* pliers, called seating pliers, is used to complete the seating of the lock. It has two grooves in the beaks, one for maxillary and the other for mandibular teeth. The grooves fit over the twin wires and force them in the seat of the male part, and at the same time the beaks are closed, which completes the seating of the cap, as in *A*, Fig. 7. In removing the lock, the procedure is reversed. The end tubing is manipulated with pliers which has a 0.036 inch groove in the beaks, *F*, Fig. 7.

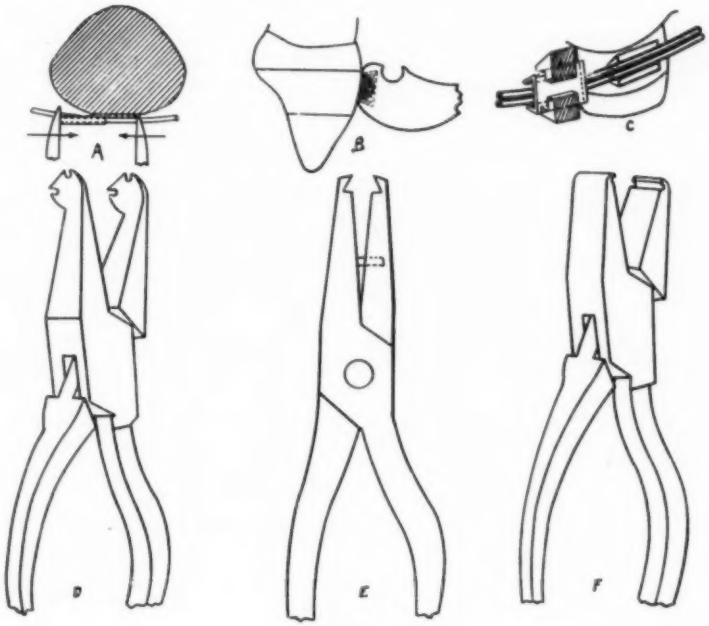

Fig. 7.

Before going farther I shall explain why I use two small wires instead of one large one.

(1) A small wire is much more resilient or springy than a large one. The small steel double wire that I use in the arch will spring back to its original form when bent out of shape, but a single wire of the same small diameter does not exert enough force to move a tooth. So, by doubling the wire, I obtain an alignment arch which has enough resiliency to spring back to its original shape when distorted, and is strong enough to move a tooth. I have found through a series of experiments over a number of years that the 0.010 inch wire is the best size to use. It will bear an eight-ounce force of distortion before a crimp is formed in it. This makes the appliance almost foolproof; for, if it takes more than eight ounces of pressure to seat the arch in the lock, it crimps and prevents one from exerting too much pressure on the tooth.

(2) With two wires I obtain bodily movement of the teeth; also there is a torque in the arch which tips the apices into normal position. There are, however, a few cases in which I desire more forward tipping of the apices than the arch is capable of exerting. In that case I draw a 0.018 inch steel wire into the end tubes in the same manner as I do the twin wire. I flatten

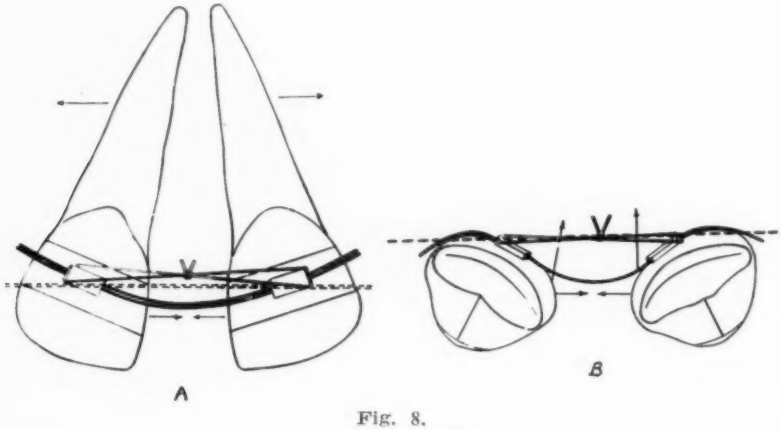

Fig. 8.

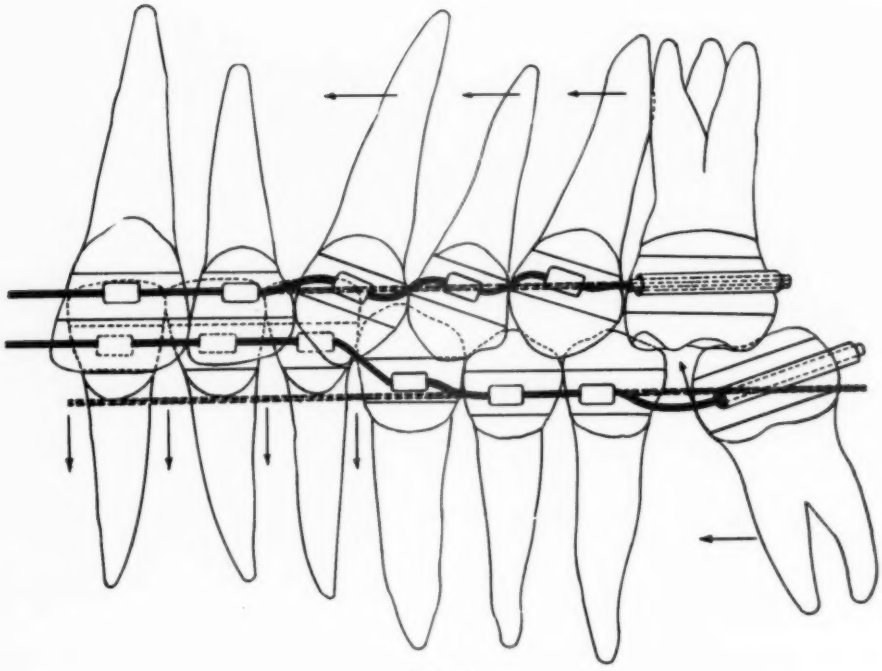

Fig. 9.

this wire by passing it through a gold-rolling machine. With practice one can roll any desired pitch or torque into this wire.

While the wires fit the channel of the lock accurately, there is still enough play to allow the teeth to slide along the wires mesially or distally. This is necessary in order to gain enough space for the rotation of the teeth. If this sliding should not be desired, a drop of cement is put into the cap before it is slipped over the male. Frequently, when anterior teeth are being moved

labially, they will slide along the twin wires and become separated. To prevent this I usually use a figure-of-eight wire ligature as shown in Fig. 8, or a cemented lock as just mentioned.

With the arch wires measuring 0.010 inch and the seat of the lock 0.011 inch, enough play exists to allow individual tooth movement instead of a rigid locking of teeth to arch. The smallness and resiliency of the twin wires aid the same desirable end.

I do not advocate the use of this appliance to widen the arch in the premolar and molar regions, because I believe the result can be secured easier

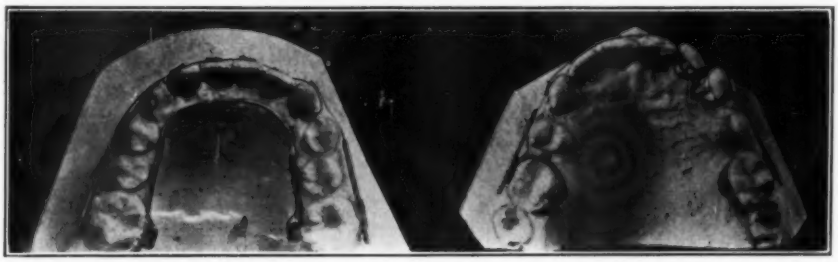

Fig. 10*A*. Fig. 10*B*.

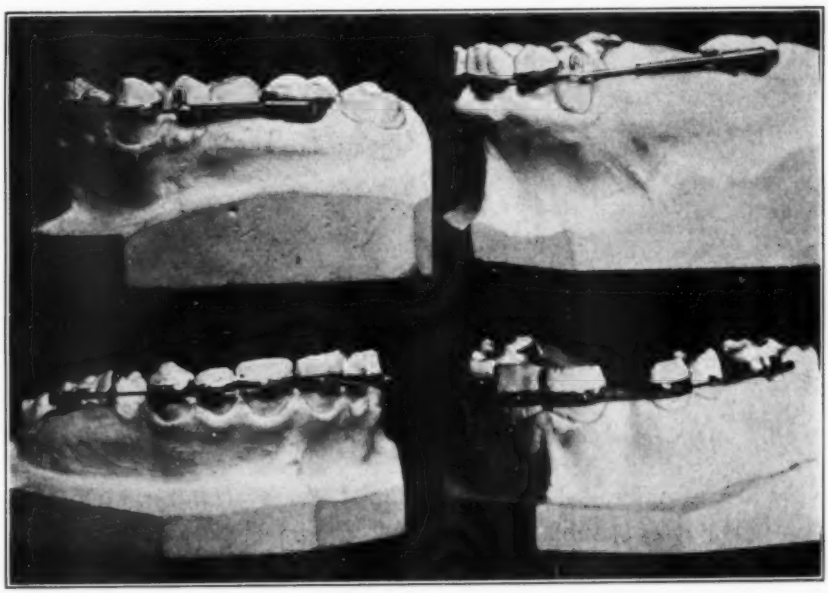

Fig. 11.

and better with a lingual appliance. In some few cases, where the crowns of the canine and premolars are tipped forward, Fig. 9, the apices of the teeth can be tipped forward very readily with the appliance and the teeth brought into a perpendicular position. I also use bands on the premolars in treating open-bite cases.

When I first began to use the twin-wire arch, I used the two methods shown in Fig. 10 to stabilize the molar anchorage. In *A*, a lingual appliance was used. When a lingual appliance was not desired, for example, when we wished to move molars distally, the arch was locked to the anterior

teeth and the ends were bent to lie passively over and parallel to the tubes on the molar bands, *B*, Fig. 10. Later I discovered that the outward force of the ends of the arch was so slight that there was no need to shape it. It, however, can be placed in the molar tubes, in the form in which it is drawn in the vise, for it has no effect on the molar anchorage. When it is slipped into the molar tubes, it automatically assumes the shape of a normal dental arch; and there is no need to shape it in any way, except to lay it on a flat surface to see that it lies in a horizontal plane.

Only two auxiliary accessories are used with the arch. One is the figure-of-eight ligature, shown in Fig. 8, which is used to draw teeth together. I use either a 0.010 soft wire ligature or a medium silk ligature. The second is the coil spring illustrated in lower models, Fig. 11, to open spaces for unerupted teeth. This coil is also used to move teeth together, eliminating the use of

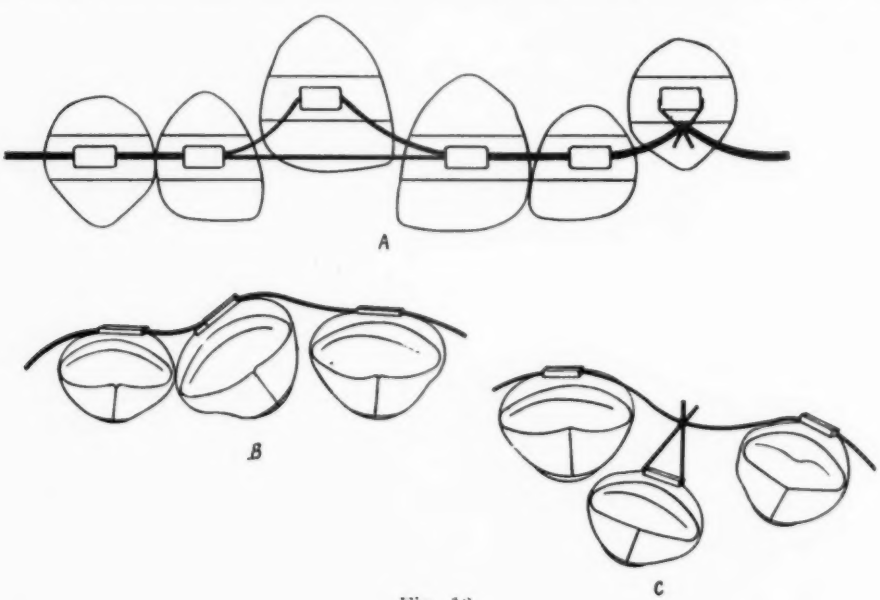

Fig. 12.

the figure-of-eight wire. It is made of 0.007 inch stainless steel wire. It is wrapped over a 0.020 inch core in a dental engine. Before the arch is assembled, a coil of the proper length is selected and slipped over the twin wire. When the arch is placed in the mouth, the coil is moved between the teeth to be separated. The caps are seated, which compresses the spring, forcing the teeth apart, and they slide along the arch and, of course, are moved bodily. This is a most satisfactory auxiliary, as you will see later in some of the cases I report. I also use coil springs to move molars distally, top models Fig. 11. I wrap these on a 0.032 inch core, and when they are stretched they fit snugly over the 0.036 inch end tube. The lower models show the coil as used to open lateral space and to shift cuspids distally.

Some teeth are so irregular that it is not advisable or even possible to seat the twin wires in the lock at the beginning of treatment; for example, the lateral incisor in bad lingual occlusion, as shown in *C*, Fig. 12, or the

unerupted cuspid shown in *A*, Fig. 12. Then a wire ligature is passed through the lock and ligated to the twin arch and the tooth moved until it is possible to lock it to the arch. In most of the extreme malocclusions, however, it is possible to seat the wires in the lock at the beginning of treatment. A good

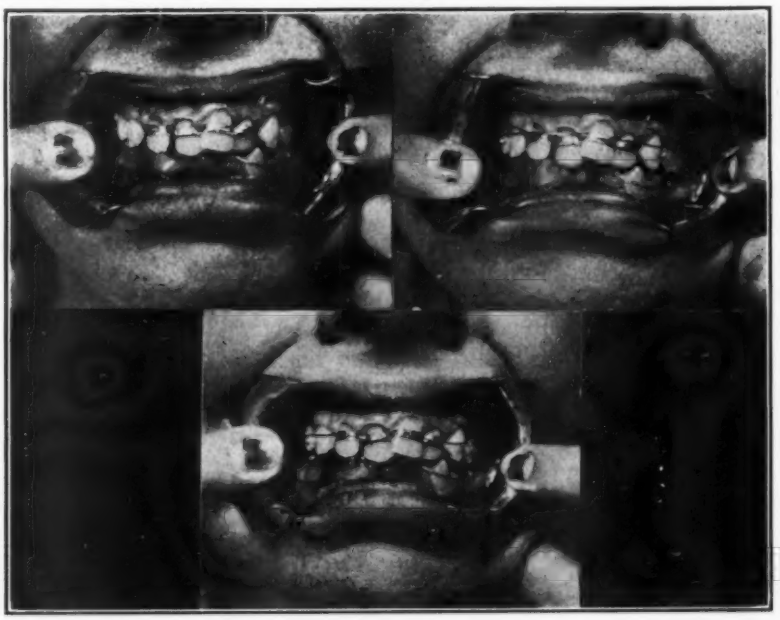

Fig. 13.

Fig. 14.

example of this is shown in the three pictures in Fig. 13. The upper figures show views of the arch before it is seated in the locks. The bottom show it after being seated and locked in place. Since it takes more than eight ounces of pressure to seat the wires on the right central incisor, they become crimped at this point and the force is very much lessened. After two or three weeks

this arch is removed. No attempt is made to straighten out crimps in the used arch. It is thrown away and a new arch is placed on the teeth. This process is continued until the teeth are in normal position.

I shall now show a number of cases which were corrected with the twin-wire appliance. In selecting these cases I have endeavored to pick some of each variety of malocclusion with which we come in contact. I have tried

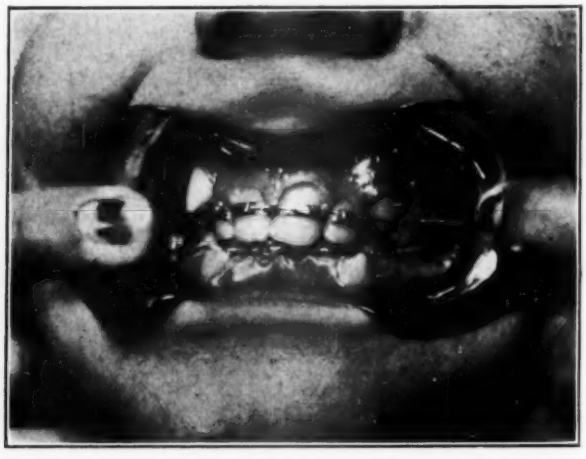

Fig. 15.

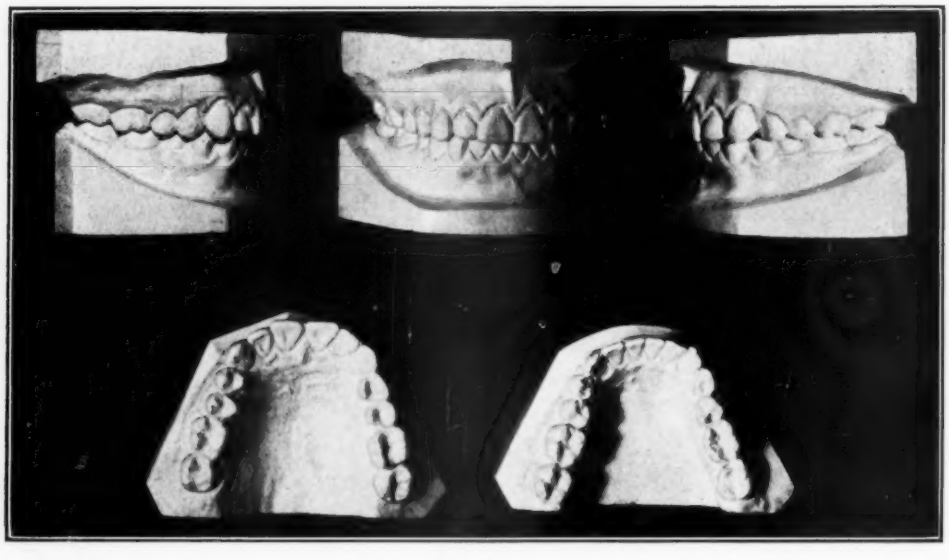

Fig. 16.

to obtain oral pictures of the appliances similar to those used in treating the cases. The pictures are not of the cases shown, for when I worked on these I had no idea of ever showing them.

I shall make the description brief and shall not attempt to explain how I arrived at my diagnosis, as this paper is on an appliance and not on diagnosis.

The first case, Fig. 14, is a typical neutroclusion with impacted maxillary canines and was treated with an appliance similar to the one shown in Fig.

15, except that bands were used on the mandibular incisor as well as on the maxillary. I diagnosed this case as a shifting forward of the molar and bicuspids of both maxillary and mandibular arches, and therefore I used coil springs on both the upper and lower appliances to move these teeth distally.

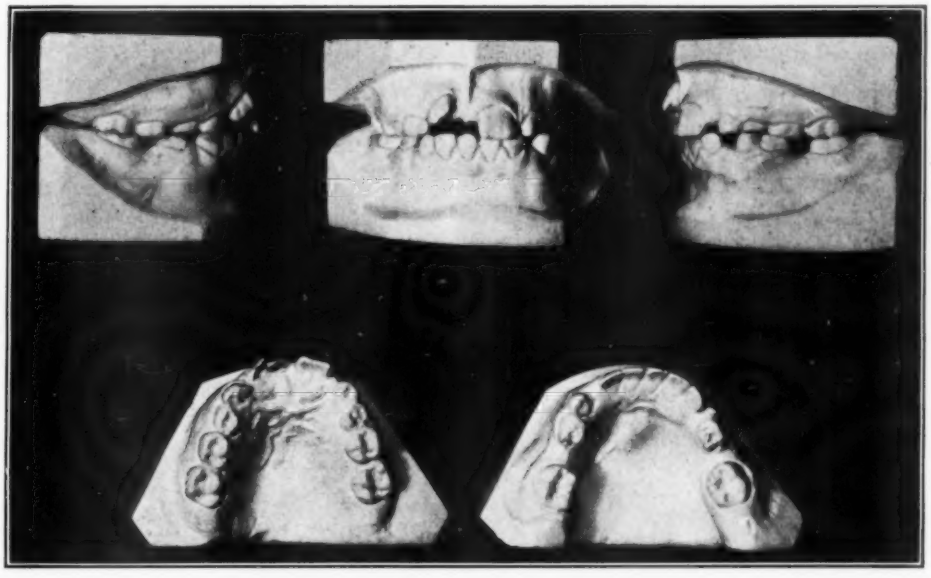

Fig. 17.

Fig. 18.

The mandibular was moved first, and, after this was accomplished, intermaxillary rubbers were used to stabilize the maxillary incisors as the coil springs shifted the maxillary molars distally. Expansion was obtained with lingual appliances. Fig. 16 shows the case one year after all appliances were removed. I should mention, before I proceed, that the Hawley plate is used

to retain the maxillary arch in all these cases. I usually retain the lower with the Crozat appliance. If the child is irresponsible, I cement the lower lingual retainer.

The next case, Fig. 17, is a neutroclusion with a supernumerary between the maxillary central incisors, complicated by the absence of lateral incisors.

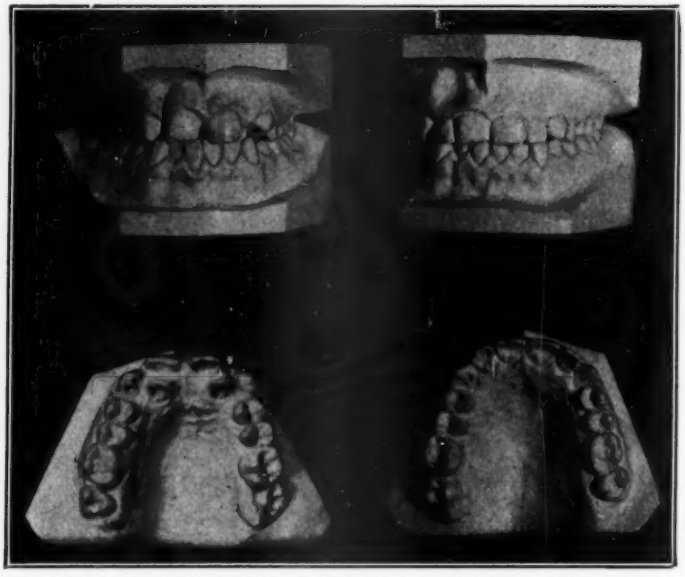

Fig. 19.

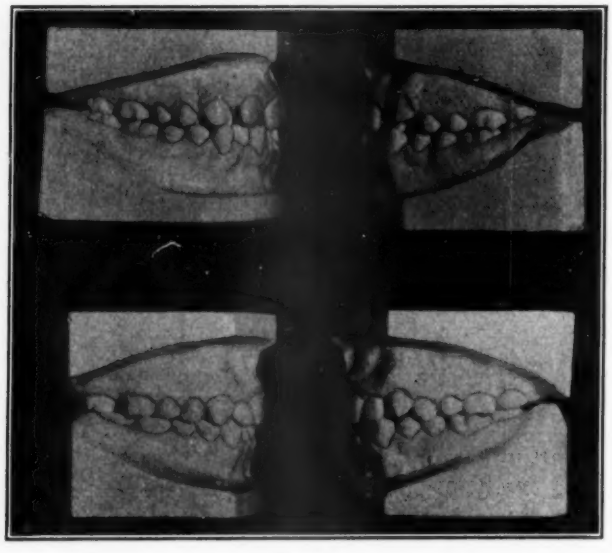

Fig. 20.

Bands were placed on the central incisors and deciduous cuspids, and the permanent first molars were used for anchorage; then, after the right central incisor had been elongated and rotated, an 0.010 inch wire ligature forming a figure-of-eight, as shown in Fig. 8, was used to draw the right central in contact with the left. The lock was cemented on the left central and a stop

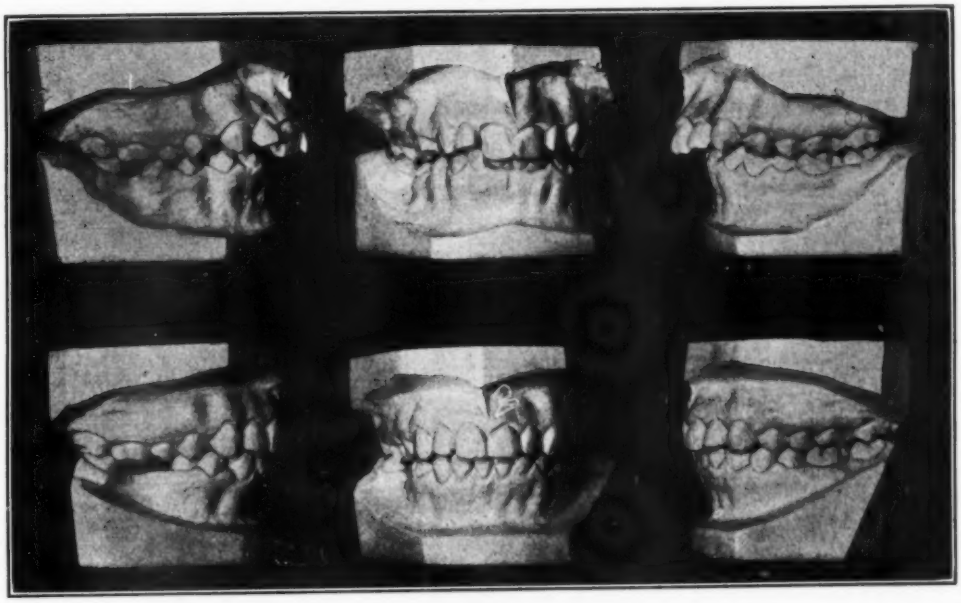

Fig. 21.

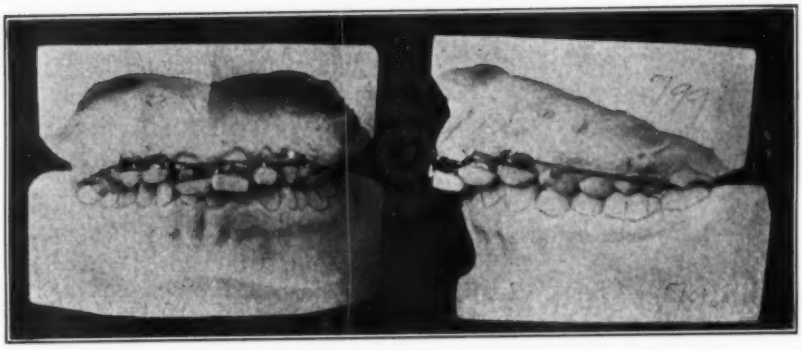

Fig. 22.

Fig. 23.

pinched in the end tube on the right molar. I make this stop by flattening the tube with a sharp nose plier, preferably the Young plier. This holds the left central stationary while moving the right. When the cuspids erupted they were banded and drawn along the arch with the figure-of-eight wire ligature. The molars and bicuspids were drawn forward with four ounce rubber bands. Fig. 18 shows results two years after all appliances were removed.

The next case, Fig. 19, is a neutroclusion with maxillary lateral incisors in lingual occlusion. The spaces for the lateral incisors were opened with coil springs as shown in Fig. 11. The lateral incisors were drawn forward by passing a 0.010 inch wire ligature through the lock on the band as illustrated in *C*, Fig. 12. When the lateral incisors were moved forward enough to seat the twin wire, the movement was completed in the usual way. Please note the upright position of the lateral incisors. Fig. 20 shows side views of the case.

Fig. 24.

Fig. 21 shows a neutroclusion case complicated by the loss of the right first molar. The lower set of models shows the case when the bridge was inserted. The appliances used in treating this case are shown in Fig. 22. This illustration was shown when I first presented the appliance at the meeting of the American Dental Association at Memphis, and was published in the J. A. D. A. of June, 1932. I still use these two methods of depressing teeth. Fig. 23 is an oral picture made two years after all retention was discontinued. Note that the overbite has remained the same.

Fig. 24 represents the case of a twelve-year-old girl with four anterior incisors in lingual occlusion. The twin-wire appliance was adjusted to the six anterior teeth. Then coil springs of 0.009 inch wire were placed over the end tubes. An appliance was placed on the lingual with spurs against the mesial of the first bicuspids. No appliance was placed on the mandibular

teeth. I depended on the lingual arch for anchorage. The lower models show the results in six months.

Fig. 25 shows an open-bite case with the first molar and bicuspids on the right side in lingual occlusion. The maxillary arch was expanded with a

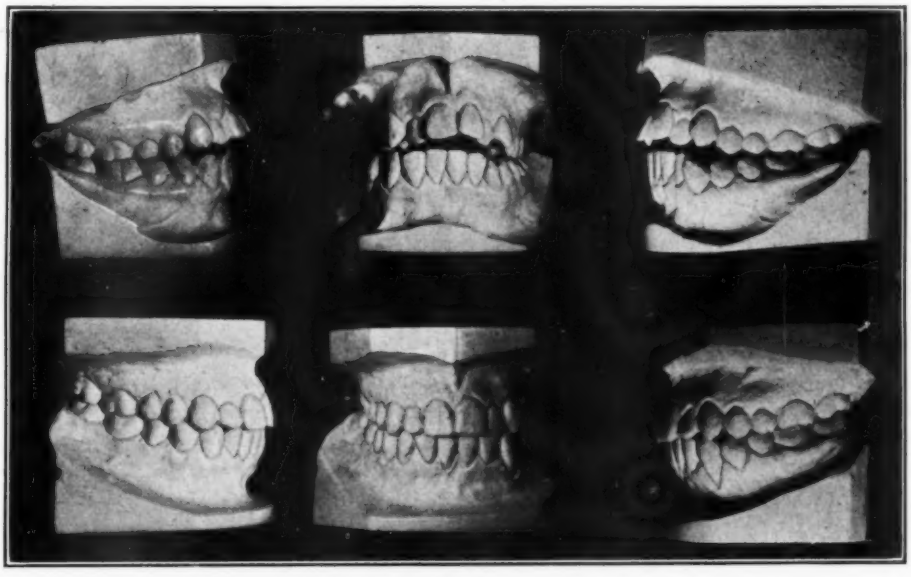

Fig. 25.

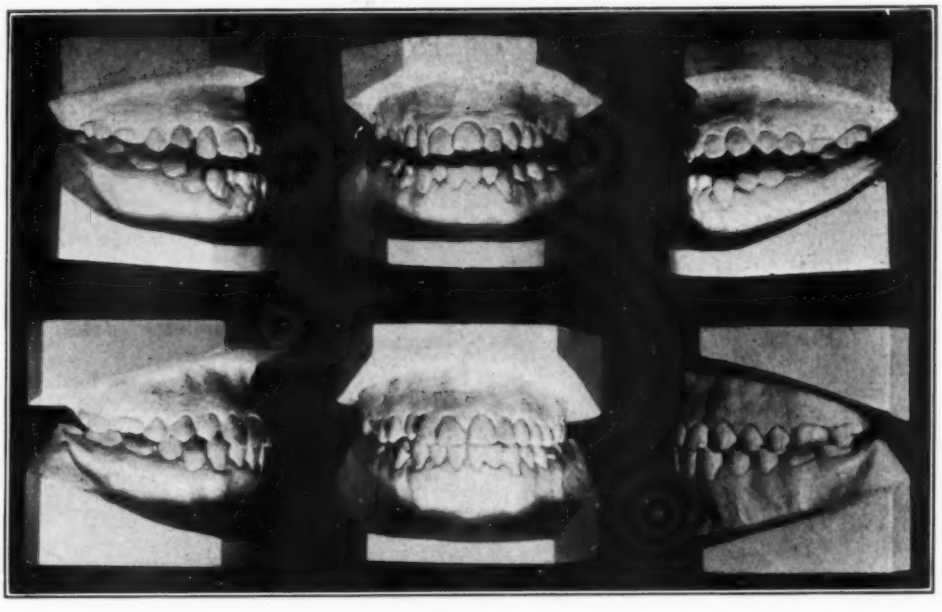

Fig. 26.

lingual appliance. The molar tubes were soldered so that the twin wire lay below the locks and was then sprung into position and locked in place, lower models in Fig. 30. Four ounce intermaxillary rubbers were used as in distocclusion cases. Lower models show the case two years after all retention was discontinued.

Fig. 26 is a more exaggerated type of open-bite with the right maxillary cuspids impacted. Bands were placed on all teeth from the first molar forward. The midsection of the twin arch was lengthened until only a short tube, the length of the molar tube, was used for the end tubes, as illustrated in

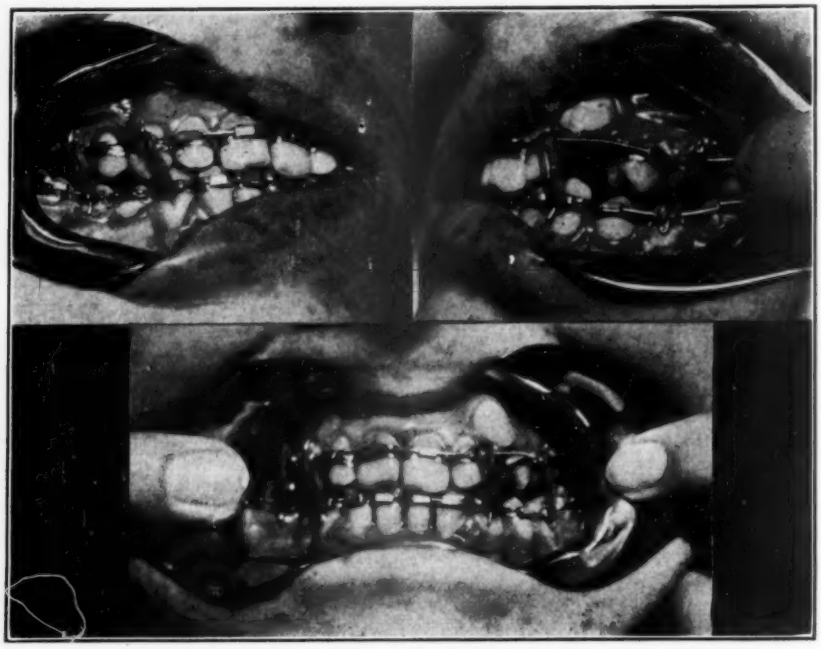

Fig. 27.

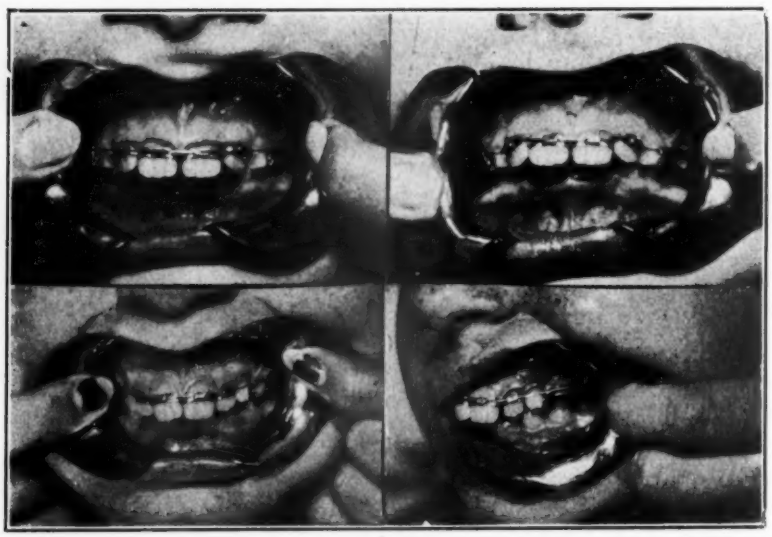

Fig. 28.

Fig. 9. Spurs were soldered to the caps on two bicuspids and lateral incisors, and intermaxillary rubbers were worn as shown in Fig. 27. The space for the right cuspid was opened with 0.009 inch coil springs wrapped on a 0.020 inch core.

The lower models in Fig. 26, show the case after one year of treatment. The first molars were not elongated because the occlusal surface was destroyed by atrophy and the dentist thought it best to build them up with inlays. The

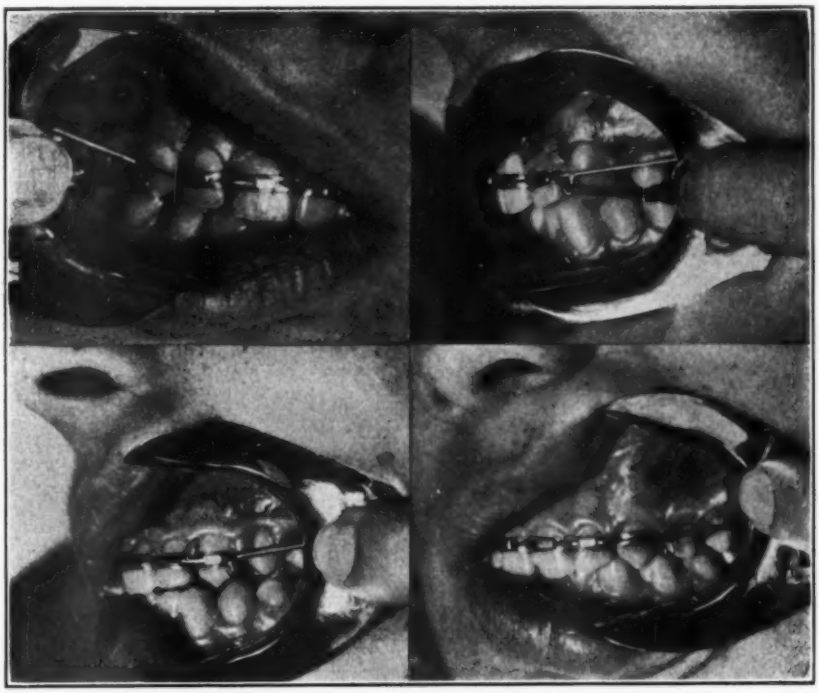

Fig. 29.

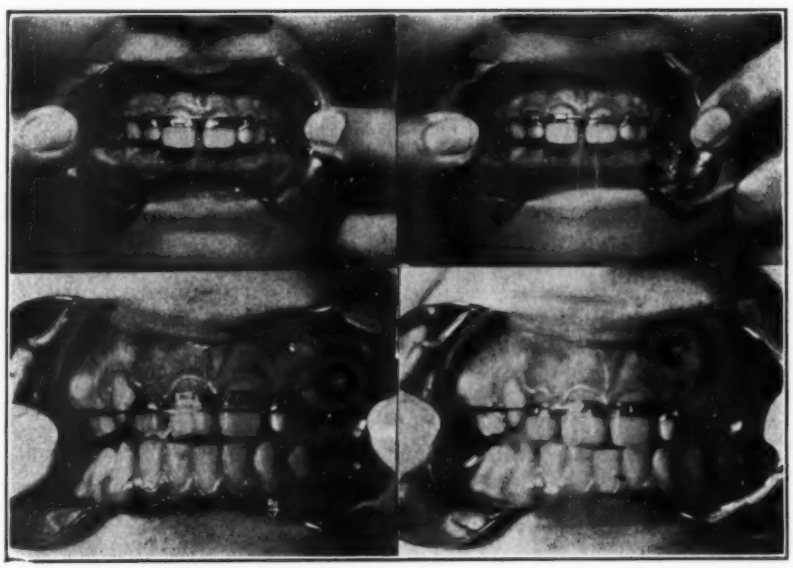

Fig. 30.

case is being retained with a Hawley appliance on the maxillary, which has a finger moving the right cuspid into alignment. The mandibular teeth were retained with a lingual bar from cuspid to cuspid.

I shall now show several types of Class II or distoclusion cases. The oral pictures, Fig. 28, show the typical appliances used in treating this type of case; from four to six maxillary incisors are banded, depending on the case. The intermaxillary hook usually lies opposite the distal surface of the cuspid.

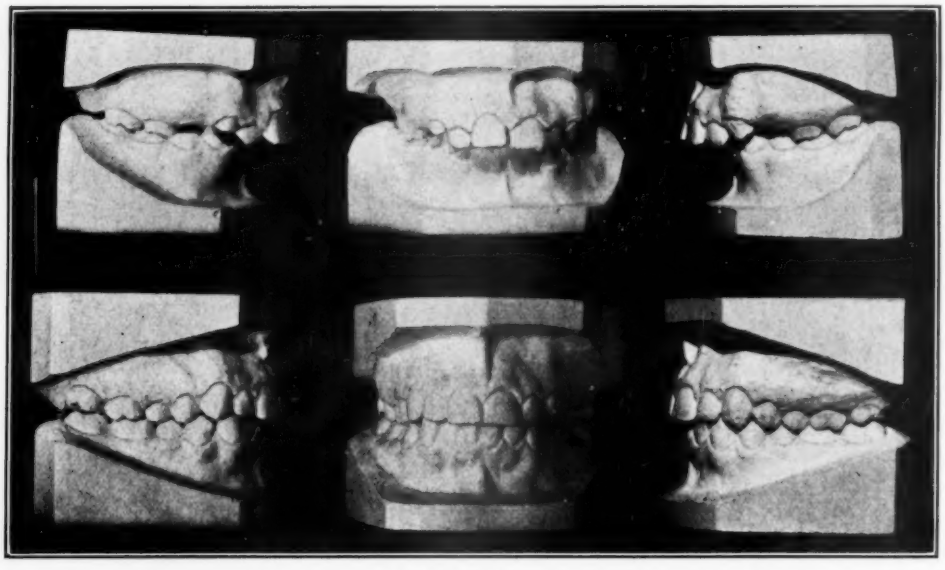

Fig. 31.

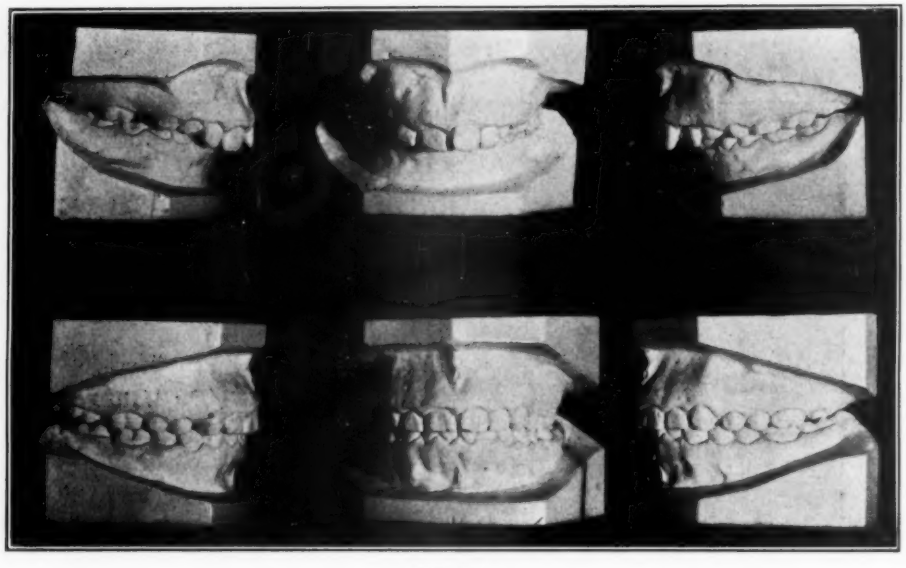

Fig. 32.

If cuspids are banded, this hook is placed just far enough back so as not to interfere with seating of the lock.

Fig. 29 shows different positions of the hook. I use intermaxillary rubbers that exert a force of five ounces. If the bite is to be opened, the molar tubes are soldered so that the arch lies to the gingival, upper pictures Fig. 30, where it is drawn down and fastened into position. If the bite is to be closed, the

tubes are soldered so the arch lies near the incisal, lower pictures Fig. 30. A lingual arch is placed on the mandibular teeth. If there is to be quite a bite of movement of the mandibular incisors, I use a twin arch to move them, sometimes with bands on the incisors; but frequently the arch is ligated to

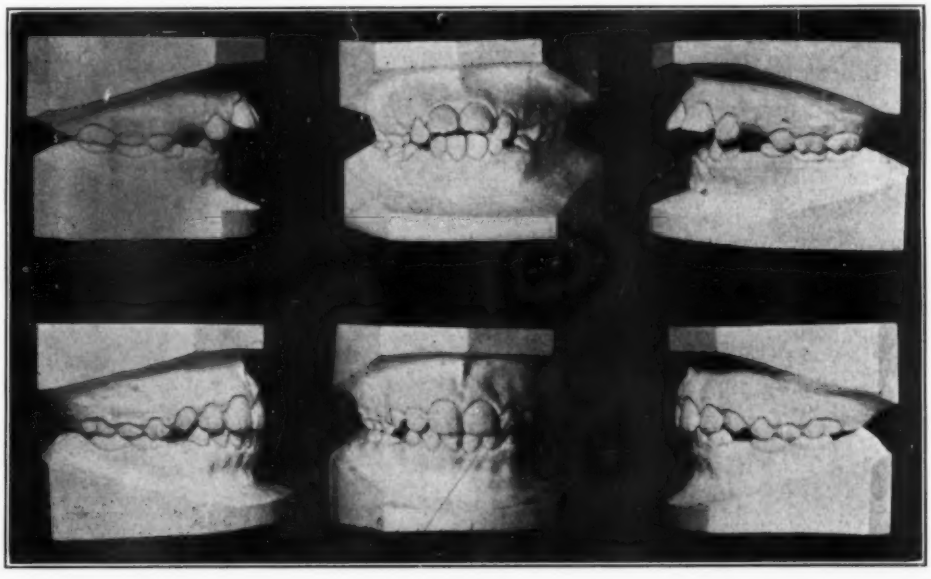

Fig. 33.

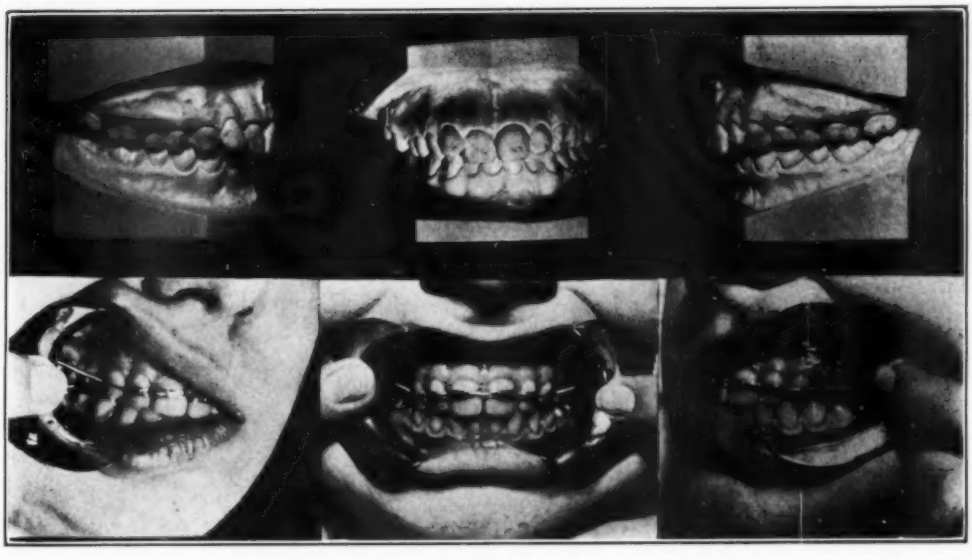

Fig. 34.

the incisor teeth with a 0.010 inch wire ligature. Coil springs are used over the end tubes to move the incisors forward. It is not necessary to remove the appliance to tighten these springs. With a Young plier I compress the coil and flatten the tube which acts as a stop. After the maxillary incisors have been moved back, I put the coil springs on the upper end tubes and move the maxillary molars distally. Cases treated in this manner are retained easier and

the facial expression is better. Fig. 31 shows a case before and after treatment as just described. No retaining appliances had been worn for over a year and one half. Please note the normal overbite. I retained this with a Hawley plate with an incline plane into which the mandibular incisors close. Rogers' masseter muscular exercise is used to assist retention.

Fig. 32 represents a distoclusion where I moved the maxillary arch as far distally as I could. This patient has worn no retention for one year. Notice how the maxillary incisors were depressed.

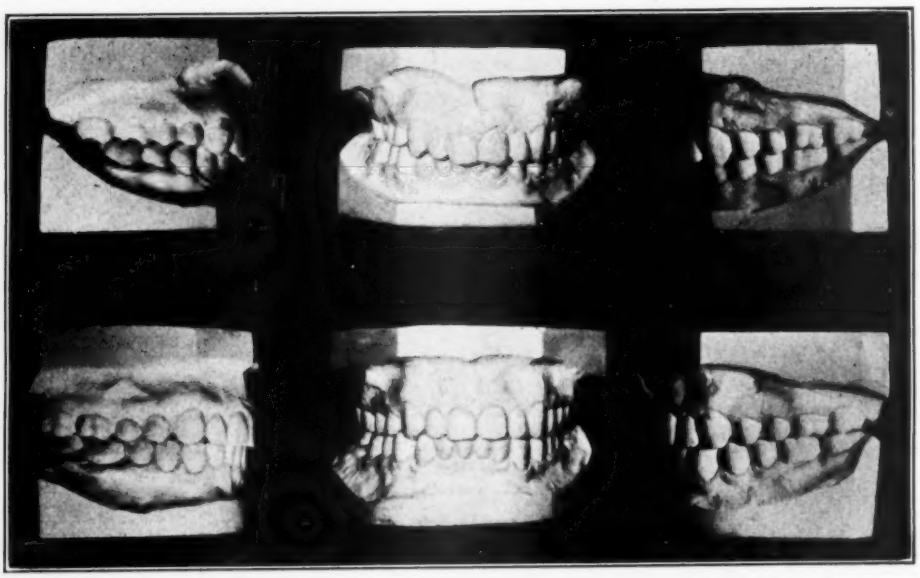

Fig. 35.

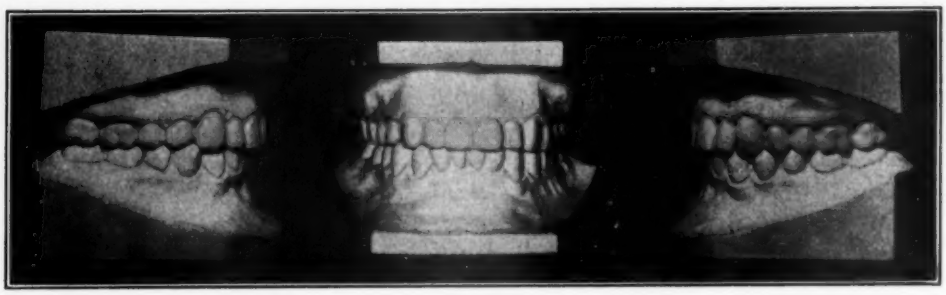

Fig. 36.

Fig. 33 shows a distoclusion with tendency to open-bite. It was treated the same as the two preceding cases, except the molar tubes were soldered so that the twin arch lay below the locks, and was sprung up in position and locked in place as illustrated in lower pictures Fig. 30. Notice that the lateral incisors have been shortened. This was done by placing the lateral bands near the incisal edge. The lower models show the case at the end of six months of treatment.

Fig. 34 is a unilateral distoclusion. I treated this case the same as the bilateral except I always move the maxillary molar distally on the affected

side. The oral pictures show this case with the appliances in position and the results after four months' treatment. The teeth are now in normal occlusion.

Fig. 35 is a good example of this type of treatment. This was a case of a twenty-year-old boy who had been under orthodontic treatment for eight years before he came to me. You will note a supposed complete distoclusion on the right side. The first molar is in lingual occlusion. I had the third molar on that side removed and treated this case as a mesial shifting of the teeth on that side. The lower models show the case at the end of a year when appliances were removed and retention started. Fig. 36 shows the case as it is at the present time, two years after all retention was discarded.

Fig. 37 shows a case treated as a mesial shift of the maxillary arch instead of a distoclusion. In this case I extracted the two first maxillary bicuspids. The lower models show the finished case after retention was discontinued.

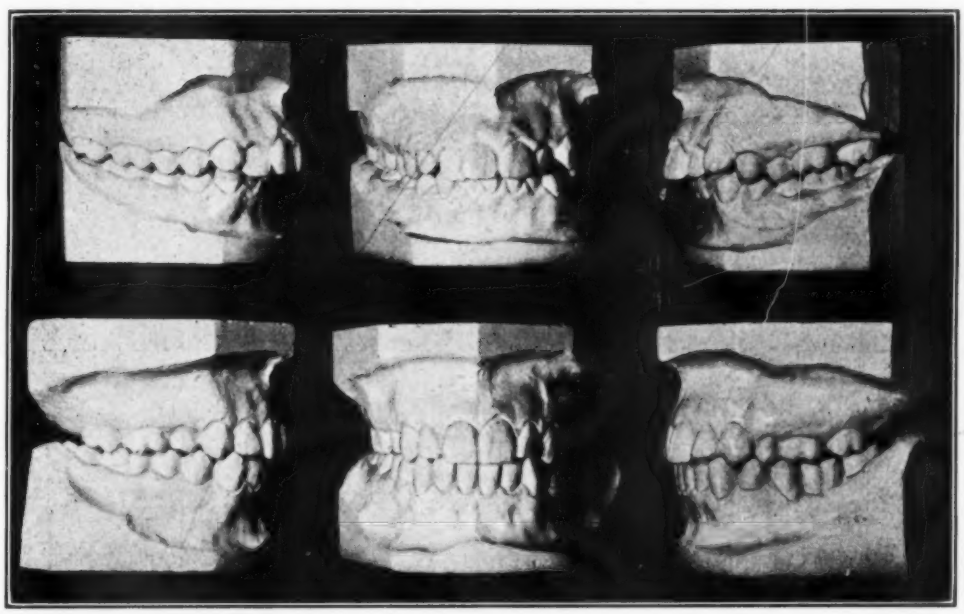

Fig. 37.

Cuspids were moved distally with coil springs placed between them and the lateral incisors as shown in the lower models Fig. 11. Then intermaxillary rubbers were used to move the four incisors back.

I shall now show some mesial or Class III cases. In this type of case I band the six maxillary and six mandibular incisors and use five-ounce intermaxillary rubbers from lower to upper. The hook is placed on the mandibular twin arch just distal to the cuspids.

Fig. 38 shows a simple mesioclusion, with linguoversion of all the maxillary bicuspids and molars on the right side. I had to open up the space for the maxillary second bicuspid on the left side, which was done with a coil spring over the end tube. Lower models show case when retention was discarded. The patient was in the office last month, and occlusion is still good after a lapse of three years, Fig. 39.

Fig. 40 is a bad mesioclusion complicated by loss of the left maxillary first molar. Lower models show case at present time, after one year's retention.

I shall now show you a case, Fig. 41, which I suppose is a Class II, division 2. This case worked very nicely, as shown in Fig. 42. I was very proud of the results, but look at the results three years later, Fig. 43. Here we have a complete distoclusion with a tendency to open-bite, also a broken central incisor. This boy developed infantile paralysis during the time he was under

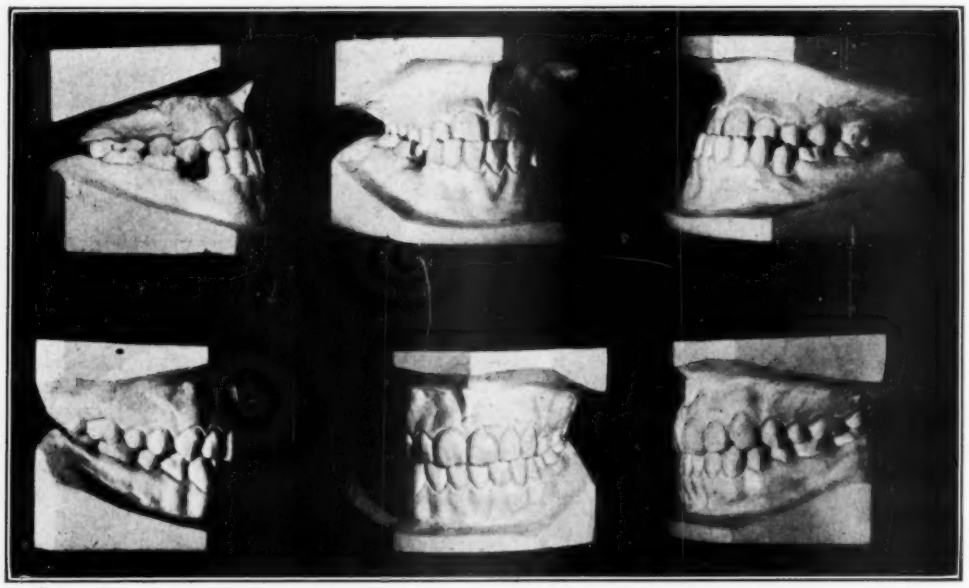

Fig. 38.

Fig. 39.

treatment. It was a mild case, and aside from a slight limp did not seem to have left any other ill effects. It evidently, however, has affected the mandible, for when he returned, after an absence of three years, he had a very decided mandibular retroversion.

With your indulgence I am going to digress from my paper on the twin-wire appliance and show you how I am treating this case. I believe it is a new form of treatment for that most discouraging type of case, the mandibu-

lar distoclusion in which there is a decided lack of development of the mandible. I have used this form of treatment on three other patients before I started work on this one, with gratifying results; now instead of dreading this type of patient, I look forward to seeing them come into the office.

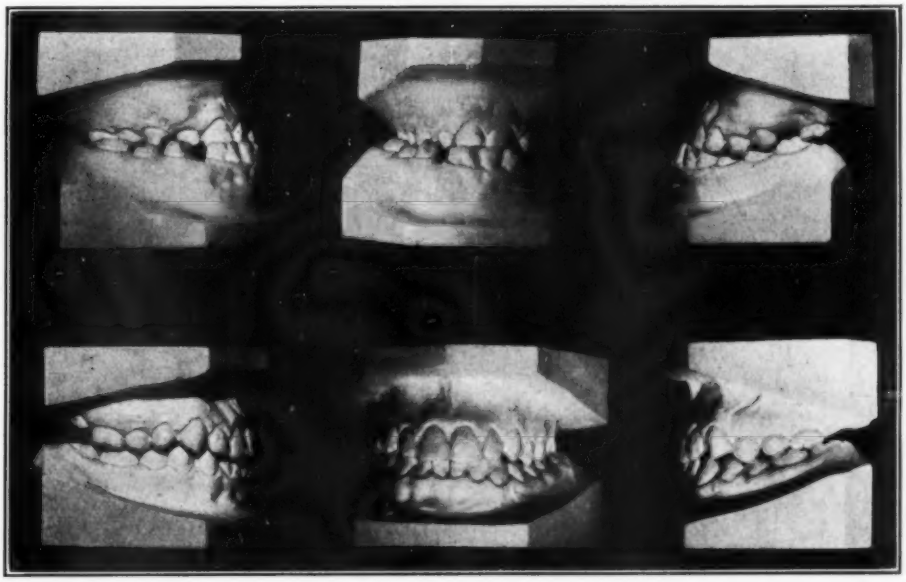

Fig. 40.

Fig. 41.

Briefly this is the way they are treated: I have them bite forward until the teeth are in a normal occlusion and then lock the two jaws together so that they cannot drop the mandible distally. In other words, I reposition the mandible.

Fig. 44 shows how this is accomplished. I band the first bicuspid and molar in each arch on both sides, then take modeling compound impressions,

also a wax bite with the mandible biting forward in the position in which I want to lock it. Then I mount the models in an articulator. With a series of 0.040 inch tubes soldered as in the upper left picture of Fig. 44, the two arches are fastened together with a cotter pin. The right picture in Fig. 44 shows

Fig. 42.

Fig. 43.

the cotter pin removed and the lower tube turned down out of the way so as not to interfere with mastication. The oral pictures show the appliance on the boy. This permits the patient to eat in comfort. I try to have the patient remove the pin only once daily and to subsist on liquids the other two meals.

The results obtained by this form of treatment are most gratifying. In fact, one case on which I had been working for five years responded satisfactorily in two months, and when the child was at home from school at Christmas I found that there had been no tendency for the mandible to slip distally.

The following is a summary of the advantages of the twin-wire appliance:

1. Simplicity in construction and operation.
2. The teeth are moved automatically to normal arch form.
3. We automatically obtain root as well as crown movement.
4. Teeth are moved rapidly, without discomfort and with no injury to tissues.
5. The appliance is very easily kept clean.

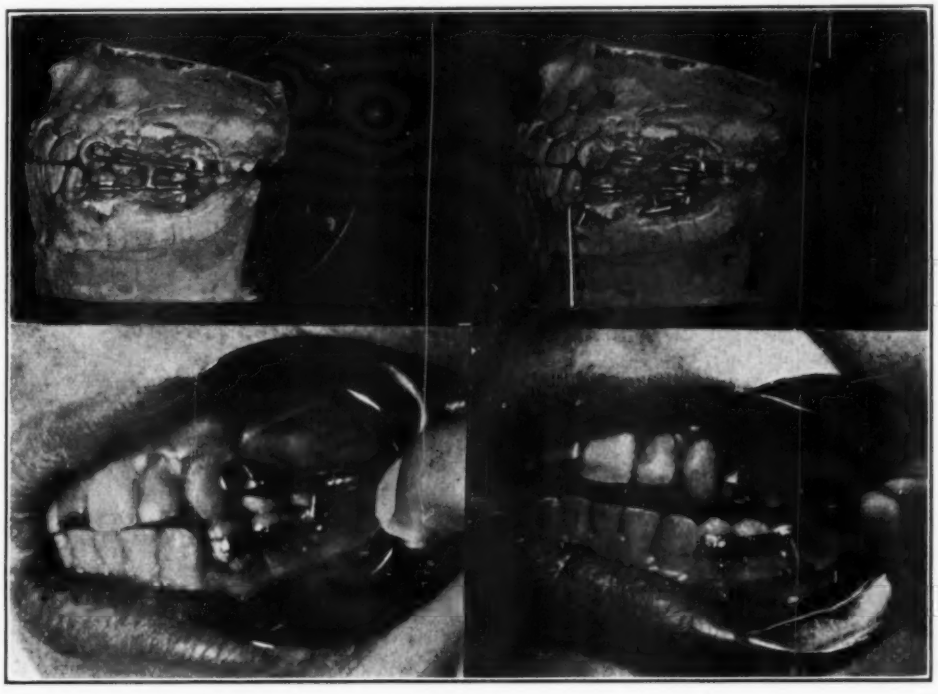

Fig. 44.

6. Despite its fragile appearance, it is strong and is seldom broken by the patient.
7. It continues to work over a long period of time. Often upon removal, after three or fourth months, I have found it still exerting pressure.
8. It is very neat looking.
9. The pressure, while light, is constant and produces physiologic tooth movement.
10. The operator has complete control of the force.
11. Bite planes are eliminated. In none of the cases shown were they used. In fact, in my office, the bite plane is considered as obsolete as the model T Ford, except when used on a Hawley retainer.

752 Starks Building

HEREDITARY INFLUENCE OF MALOCCLUSION

I. Statistical Studies on the Heredity of Progenia*

Hirosi Iwagaki,† D.D.S., Tokio, Japan

OUR knowledge on the hereditary nature of dental variations has been very meager, as Dr. Keeler pointed out in his excellent paper, "Heredity in Dentistry."[1] Dr. Keeler is probably the first man who studied those problems from the point of recent advances of the genetic sciences, but without any decisive conclusion.

Hamano[2] (1920) and Korkhaus[3] (1931) gave some histories of progenia. Korkhaus believes that the character is a mendelian dominant. It is, however, very difficult to decide whether the character is a mendelian dominant or recessive because the presence of the character among the population is not very rare; indeed it is so frequent that it is quite possible to find some families in which one of the parents and some of their children show this trait coincidently. Therefore we cannot conclude as yet from these few histories of progenia even its hereditary nature.

For this reason I discarded the method of such research, i.e., collecting a few histories with exact observation of each case. I chose rather to collect material from many people and to analyze the data statistically. This method is much better for the present state of our knowledge and as a preliminary study in this field, although the diagnosis obtained from this source of investigation is not altogether satisfactory.

The material for this study was obtained as follows: I asked the dental students of several colleges in Japan to tell me about themselves and their families, whether they were progeneous or not. Special recording cards were printed as shown in Table I, and the students were asked to fill out the cards.

I am deeply indebted to the deans of the colleges and the students for their generous cooperation in this study; 2,461 histories were collected and analyzed from the viewpoint of mathematical statistics.

PART I. PROOF AS TO THE FAMILIAL NATURE OF PROGENIA

First of all, the material must be analyzed to prove the familial nature of the character, without any assumption as to which of the influences, hereditary or environmental, is prevalent for the development of progenia.

Tables II to IV give clear-cut proof of the familial nature of the character. No detailed explanation is needed.

*The meaning of the word "progenia" as used in this paper includes both of the traits, so-called "mandibular protrusion" and "edge-to-edge bite."

†Professor of Orthodontia, Nihon University Dental College.

PART II. MATHEMATICAL ANALYSIS

We may start from the assumption of a simple recessive factor for this trait.

TABLE I

RECORD OF MALOCCLUSION IN STUDENTS' FAMILIES

ARE THE PARENTS OF THE STUDENT CONSANGUINEOUS? YES OR NO

			NAME	DATE OF BIRTH	STILL ALIVE OR DEAD	STATE OF OCCLUSION
Student's Father						
Mother						
Student						
Student's Brother	Elder	1st				
		2nd				
		3rd				
		4th				
		5th				
	Younger	1st				
		2nd				
		3rd				
		4th				
		5th				
Student's Sister	Elder	1st				
		2nd				
		3rd				
		4th				
		5th				
	Younger	1st				
		2nd				
		3rd				
		4th				
		5th				

Students are requested to study very carefully the following questions. (1) If parents are consanguineous, it is desirable to answer in detail the relation of father and mother. (2) Care should be taken not to omit the description of dead members of the family. If some relatives have died, cause of death and age at death must be added. (3) As to state of occlusion, one of the following four names may be written: maxillary protrusion, normal, mandibular protrusion, edge-to-edge bite. (4) Any kind of dental anomalies, if existing, should be noted in the additional space. (5) If student has no knowledge about some of his relatives, because of death or any other reason, he should write "unknown."

TABLE II

PERCENTAGES OF PROGENEOUS CHILDREN ACCORDING TO VARIOUS COMBINATIONS OF THE PARENTS

COMBINATION OF THE PARENTS		CHILDREN		
FATHER	MOTHER	TOTAL NUMBER	NUMBER OF PROGENIA	PERCENTAGE
Progen.	Progen.	---	---	---
Not Progen.	Progen.	235	42	17.88 ± 2.50
Progen.	Not Progen.	121	38	31.40 ± 4.21
Not Progen.	Not Progen.	10,454	394	3.77 ± 0.19

Let "A" represent the percentage of progenia in a population and "x" the probable frequency of the gene for progenia in a population.

Theorem 1. As is well known

$$x = \frac{\sqrt{A}}{10}$$

TABLE III

PERCENTAGE OF THE PROGENEOUS PARENTS ACCORDING TO PRESENCE OF PROGENIA AMONG THEIR CHILDREN

STATES OF THE CHILDREN	FAMILIES				
	TOTAL NUMBER	FATHER PROGEN.	MOTHER PROGEN.	FATHER OR MOTHER PROGEN.	PERCENTAGE
Progeneous child present	345	22	24	46	13.32 ± 1.83
Progeneous child not present	2,116	7	34	41	1.94 ± 0.30

TABLE IV

PERCENTAGE OF PROGENIA AMONG BROTHERS AND SISTERS OF STUDENTS WHOSE PARENTS ARE NOT PROGENEOUS, ACCORDING TO THEIR STATE

STATES OF THE ANSWERING STUDENTS	BROTHERS AND SISTERS		
	TOTAL NUMBER	NUMBER OF PROGENIA	PERCENTAGE
Not progeneous	7,680	216	2.81 ± 0.19
Progeneous	397	57	14.43 ± 1.76

Theorem 2. Let "P" represent the probability that one of the parents of a progeneous child is also progeneous. Then

$$P = 2\ (x - x^2) = 2\left(\frac{\sqrt{A}}{10} - \frac{A}{100}\right)$$

Theorem 3. Let "B" represent the probability that both of the parents of a progeneous child are also progeneous. Then

$$B = x^2 = \frac{A}{100}$$

Theorem 4. The probability that parents one of whom is progeneous and who have at least one progeneous child, might have another progeneous child in the future equals $\frac{1}{2}$.*

Theorem 5. The probability that parents both of whom are normal, and who have at least one progeneous child, might have a progeneous child, equals $\frac{1}{4}$.†

Theorem 6. The probability that parents both of whom are progeneous and who have at least one progeneous child will also produce a progeneous child equals 1.*

Theorem 7. The probability that parents one of whom is progeneous, will produce a progeneous child equals $\frac{x}{1 + x}$.

Theorem 8. The probability that parents both of whom are not progeneous will produce a progeneous child equals $\frac{x^2}{(1 + x)^2}$.

*Computation should be performed according to Weinberg's formula in this case

$$\frac{\Sigma\ (l - 1)}{\Sigma\ (n - 1)} = \tfrac{1}{2}$$

l, number of progeneous children; n, number of all children, - 1, subtraction for the progeneous child found first.

†Weinberg's formula also should be used.

Theorems 1 to 6 are so easily proved that they are not worth troubling about.

Proof of Theorem 7: Let "N" represent the gene of the normal state (including the cases of maxillary protrusion) and "P" the gene of progenia. The parents one of whom is progeneous should be of the form NN × PP, and NP × PP.

$$\text{The probable frequency of NP} = 2x\ (1 - x)$$
$$\text{and that of NN} = (1 - x)^2.$$

NP × PP parents will have a progeneous child with the probability of $\frac{1}{2}$

NN × PP parents can never have a progeneous child. Therefore

$$\frac{1}{2} \times \frac{2x\ (1 - x)}{2x\ (1 - x) + (1 - x)^2} = \frac{x}{1 + x}$$

should express the probability that the parents one of whom is progeneous can produce a progeneous child.

Proof of Theorem 8: The parents both of whom are normal (including maxillary protrusion) should be of the forms NP × NP, NP × NN, or NN × NN.

The relative frequency of each kind of parent is calculated on the following diagram.

NP $2x\,(1-x)$	NN $(1-x)^2$	♀ / ♂
NP × NN $2x\,(1-x)^3$	NN × NN $(1-x)^4$	NN $(1-x)^2$
NP × NP $4x^2\,(1-x)^2$	NN × NP $2x\,(1-x)^3$	NP $2x\,(1-x)$

The relative frequency of

$$\text{NN} \times \text{NN} = (1 - x)^4$$
$$\text{NP} \times \text{NN} = 4x\ (1 - x)^3$$
$$\text{NP} \times \text{NP} = 4x^2(1 - x)^2$$

Only the parents NP × NP will have progeneous children with the probability of $\frac{1}{4}$. Therefore the probability that the parents both of whom are normal will have a progeneous child is

$$\frac{1}{4} \times \frac{4x^2\ (1 - x)^2}{4x^2\ (1 - x)^2 + 4x\ (1 - x)^3 + (1 - x)^4} = \frac{x^2}{(1 + x)^2}$$

FREQUENCY OF PROGENIA IN THE POPULATION

This has not yet been determined exactly because the difference of criterion might influence it. Age and race might also cause differences. Table V is the collection of data found in the reports and compared with my own statistics. It is rather astonishing that the average percentage of progenia in Japanese population reported by other researchers and that of mine agree very well with each other as is shown in Table VI.

TABLE V

AUTHOR'S NAME	YEAR	QUALITY AND AGES OF EXAMINED PEOPLE	MANDIBULAR PROTRUSION				EDGE-TO-EDGE BITE			
			NAME OF TRAIT GIVEN IN ORIGINAL PAPER	TOTAL NUMBER OF PEOPLE EXAMINED	NUMBER OF PEOPLE HAVING TRAIT	PER CENT	NAME OF TRAIT GIVEN IN ORIGINAL PAPER	TOTAL NUMBER OF PEOPLE EXAMINED	NUMBER OF PEOPLE HAVING TRAIT	PER CENT
Terra	1905	Skull of German	. . . .	. .	. .	. .	Labidontie	402	67	16.7
Chiavaro	1913	Deciduous teeth 3 yr.–6 yr.	Class III	1000	26	2.6	. . .	. .	. .	. .
Thielmann	1922	Leipzig, Deciduous teeth	Mesial Occlusion	. .	. .	2.4	. . .	. .	. .	. .
Korkhaus	1927	Bonn, Deciduous teeth 6 yr.	Class III	643	17	2.6	Edge-to-edge bite	643	36	5.6
Korkhaus	1927	Bonn, 14 yr. Permanent teeth	Class III	568	3	0.5	Edge-to-edge bite	568	2	0.4
Oosima Yosimi	1933	Chinese, Permanent teeth	Mandibular Protrusion	834	3	0.36	Edge-to-edge bite	834	81	9.7
Oosima Yosimi	1933	Chorean, Permanent teeth	. . . .	. .	. .	. .	Edge-to-edge bite	41	5	12.2
Yamamoto	1919	Kyoto, 9 yr.-14 yr.	Class III	602	9	1.5	. . .	. .	. .	. .
Iwasa	1920	N. Kyusyu, 3 yr.–13 yr.	Class III	544	4	0.7	. . .	. .	. .	. .
Matuzawa	1922	S. Kyusyu, 4 yr.–14 yr.	Mandibular Protrusion	1098	1	0.1	. . .	. .	. .	. .
Saito	1922	Tokyo, Deciduous teeth	Mandibular Protrusion	200	11	5.5	Edge-to-edge bite	200	3	1.5
Kuwabara	1922	Sizuoka, Permanent teeth, 7 yr.–14 yr.	Class III	980	2	0.2	. . .	. .	. .	. .
Kono Hirose Katayama	1925	Dental students' plaster model	. . . .	. .	. .	. .	Labidontie	141	21	14.9
Enomoto	1926	Tokyo, 7 yr.-14 yr.	Class III	709	49	6.9	. . .	. .	. .	. .
Hamano	1929	Jap. adult, plaster model	. . .	. .	. .	. .	Edge-to-edge bite	40	1	2.5
Yamada	1931	Skull of Hokuroku	Progenie	103	1	0.9	Labidontie	103	5	4.8
Oosima Yosimi	1933	Japanese, Permanent T.	Progenia	467	1	0.2	Edge-to-edge bite	467	19	4.1
Nakagawa	1936	Permanent teeth, 8 yr.-25 yr.	Class III	881	20	2.2	. . .	. .	. .	. .

TABLE V—CONT'D

AUTHOR'S NAME	YEAR	QUALITY AND AGES OF EXAMINED PEOPLE	MANDIBULAR PROTRUSION				EDGE-TO-EDGE BITE			
			NAME OF TRAIT GIVEN IN ORIGINAL PAPER	TOTAL NUMBER OF PEOPLE EXAMINED	NUMBER OF PEOPLE HAVING TRAIT	PER CENT	NAME OF TRAIT GIVEN IN ORIGINAL PAPER	TOTAL NUMBER OF PEOPLE EXAMINED	NUMBER OF PEOPLE HAVING TRAIT	PER CENT
Koya	1937	Permanent teeth, plaster cast	Progenie	672	3	0.45	Labidontie	672	17	2.52
Iwagaki	1937	Plaster model of dental student	Mandibular Protrusion	850	8	0.94	Edge-to-edge bite	850	49	5.75
Iwagaki	1937	Answers of dental student	Mandibular Protrusion	2393	43	1.80	Edge-to-edge bite	2393	101	4.20

TABLE VI

Mandibular Protrusion	Japanese total data	6256 : 101	1.61 ± 0.16
	Author's statistics	3243 : 51	1.57 ± 0.22
	Total	9499 : 152	1.60 ± 0.13
Edge-to-edge bite	Japanese total data	1623 : 66	4.06 ± 0.49
	Author's statistics	3243 : 150	4.62 ± 0.37
	Total	4866 : 216	4.44 ± 0.29

Therefore, it might not be a great mistake to take the following numbers as the standard percentage of progenia for the present mathematical analysis.

Mandibular protrusion	1.6%
Edge-to-edge bite	4.4%
Progenia	6.0%

RESULTS OF THE ANALYSIS

TABLE VII

	TOTAL NUMBER OF PARENTS WHO HAVE AT LEAST ONE PROGENEOUS CHILD	ONE OF PARENTS PROGENEOUS		BOTH PARENTS PROGENEOUS
		NUMBER	%	
Observed	345	46	13.32 ± 1.83	0
Corrected			42.2 ± 2.65	
Expected			37.00	6.0

Note: The expected percentage is calculated according to the formula of Theorem 2. For instance, if we assume A = 6.0 then expected

$$100 \times P = 200 \left(\frac{\sqrt{6.0}}{10} - \frac{6.0}{100} \right) = 37.00\%$$

if we assume A = 6.0 then expected

$$100 \times B = 100 \times \frac{6.0}{100} = 6.00\%$$

The correct percentage is calculated by dividing by the exactness of the answers of the students concerning the corresponding family members.

TABLE VIII*

	TOTAL NUMBER OF CHILDREN OF PARENTS BOTH OF WHOM ARE NORMAL, BUT WHO HAVE AT LEAST ONE PROGENEOUS CHILD	NUMBER OF PROGENEOUS CHILDREN	
		NUMBER	%
Observed	1223	91	7.44 ± 0.75
Corrected			8.93 ± 0.81
Expected			25.00

*Weinberg's formula has been used for the calculation of Tables VIII and IX.

TABLE IX

	TOTAL NUMBER OF CHILDREN OF PARENTS ONE OF WHOM IS PROGENEOUS, AND WHO HAVE AT LEAST ONE PROGENEOUS CHILD	NUMBER OF PROGENEOUS CHILDREN	
		NUMBER	%
Observed	165	34	20.6 ± 3.14
Corrected			24.7 ± 3.36
Expected			50.00

TABLE X

		TOTAL NUMBER OF CHILDREN	PROGENEOUS CHILDREN	
			NUMBER	PER CENT
One of parents progeneous	Observed	356	80	22.42 ± 2.21
	Corrected			26.92 ± 2.35
	Expected			19.6
Both parents normal	Observed	10,454	394	3.76 ± 0.19
	Corrected			4.51 ± 0.21
	Expected			3.84

Notice: The expected percentages are calculated according to Theorems 7 and 8. For instance, if we assume A = 6.0, then the expected percentages are

$$100 \times \frac{x}{1+x} = 100 \times \frac{\frac{\sqrt{6.0}}{10}}{1+\frac{\sqrt{6.0}}{10}} = 19.6$$

and

$$100 \times \frac{x^2}{(1+x)^2} = 100 \times \left[\frac{\frac{\sqrt{6.0}}{10}}{1+\frac{\sqrt{6.0}}{10}}\right]^2 = 3.84$$

respectively.

EXACTNESS OF ANSWERS OF STUDENTS CONCERNING DENTAL CONDITION OF THEIR RELATIVES

Table XI shows that the students have a meager knowledge concerning the dental condition of their parents and better information of their brothers and sisters.

If we neglect these facts, the mathematical analysis above mentioned might be meaningless. The observed percentage of progenia by the parents must be multiplied by the ratio $\frac{6.0}{1.9}$, i.e., percentage among the population to that by the parents answered by the students. The observed percentage of total children must be multiplied by the factor $\frac{6}{5}$. It is only a round number because the students themselves are included. Corrected percentages shown in the Tables VII, VIII, IX, and X are thus calculated. Even such corrections are not satisfactory in the strict sense because, for instance, the parents one of whom is progeneous would sometimes be counted as normal, so that the table itself might be erroneous. Mathematical analysis taking into account these errors is too complicated and troublesome and has not been done in the present study.

TABLE XI

	TOTAL NUMBER	PROGENIA ANSWERED BY STUDENT	
		NUMBER	%
Parents	4582	87	1.90 ± 0.20
Fathers	2295	29	1.26 ± 0.21
Mothers	2287	58	2.53 ± 0.32
Brothers and Sisters	8417	330	3.92 ± 0.21
Brothers	4332	156	3.59 ± 0.28
Sisters	4085	174	4.26 ± 0.34
Students themselves	2393	144	6.02 ± 0.49
Boys	2060	123	5.97 ± 0.52
Girls	333	21	6.3 ± 1.33

PART III. STATISTICS ON THE RELATION BETWEEN PROGENIA AND CONSANGUINEOUS MARRIAGE

Since Mendel's discovery of the laws of heredity, miserable results of consanguineous marriages are recognized as a consequence of two genes causing malignant diseases. Consanguineous marriage joins two genes of the same character. If this theory is correct, we might expect that the rarer a recessive gene is in a population, the deeper must be the relation between the consanguineous marriage and the disease.

Mathematical treatment of this problem was first undertaken by a German student, Lenz,[4] 1919. Later in 1929, Dahlberg[5] extended the theory to general cases. Kawakami[6] in 1931 proposed the formula in the following form on the viewpoint of Dahlberg.

$$x = \frac{a\ (100 - A)}{16\ (100 - a)\ A - 15\ (100 - A)\ a}$$

"x" denotes the probability of the gene in the population,
"a" denotes the percentage of consanguineous marriages in the population,
"A" denotes the percentage of consanguineous marriage with reference to the corresponding disease.

Kawakami showed an example of excellent agreement of the theory and statistics by Oguchi's disease, a kind of hemeralopia found in Japan, which is inheritable as a recessive.

It would be a good thing to make a statistical study concerning consanguineous marriage with reference to progenia and to compare it with the above theoretical formula. As is shown in Table I, I asked the students also whether their parents are consanguineous or not. The results are summarized in the Tables XII and XIII.

TABLE XII

	NUMBER OF FAMILIES	FAMILIES IN WHICH AT LEAST ONE CHILD IS PROGENEOUS	
		NUMBER	%
Parents consanguineous	111	21	18.90 ± 3.71
Parents not consanguineous	1841	243	13.20 ± 0.79

TABLE XIII

	NUMBER OF STUDENTS	CONSANGUINEOUS PARENTS	
		NUMBER	%
Students progeneous	145	12	8.28 ± 2.29
Students not progeneous	2248	95	4.22 ± 0.42

Applying the value of probable frequency of progenia $x = \frac{\sqrt{6.0}}{10} = 0.244$ and $a = 4.0$ into the theoretical formula, we get 4.73 per cent as the percentage of consanguineous marriages by the parents of progeneous students, which lies not out of the range of statistical error of observed percentage. Because of the small amount of material, however, these results do not contribute toward the proof that progenia is recessive; although we have no reason for contradicting this assumption.

CONCLUSION

After collecting more than 2,000 family histories concerning progenia, I examined the hereditary nature of the trait from the viewpoint of mathematical statistics. The conclusion reached by this study, however, is rather poor. I could confirm only that this trait is familial. It is perhaps a Mendelian recessive, but there is no exact agreement between theoretical expectation and statistics. Further researches with detailed tracing of the families are needed.

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MALOCCLUSION AND ASSOCIATED DENTAL DEFORMITIES

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DENTAL dystrophies occurring in certain of my patients who were children of parents marked with Hutchinson's teeth I reported[1] in 1933. In practically every one of this group of 59, dental stigmas were present, usually involving the incisor region, and covering a wide range of defects. As the real Hutchinson's tooth is undoubtedly the result of syphilis in the preceding generation, I advanced the suggestion that infections or toxins, strong enough to have caused this major injury in the children of syphilitics, might well, through some constitutional effect, be responsible for lesser injuries to the teeth in the following generation. Such lesser injuries were not indications of syphilis in these people, but pointed rather to a *tendency* to dental malformations in certain families with a syphilitic ancestry.

In a second article, congenitally missing maxillary lateral incisor teeth were discussed in a series of cases chosen because I knew the dental conditions in the families of these particular patients and could therefore consider this defect in its familial rather than its individual aspects.[2] This study yielded two sets of facts: (1) In certain of these cases the maxillary lateral incisors were congenitally absent in the generation following a parental syphilis; but (2) these teeth were also absent in children whose parents had Hutchinson's teeth. Doubtless congenital agenesia of these teeth may sometimes be a specific indication, as held by certain syphilologists, from Fournier, 1883, to Sichel (Hauck's Clinic), 1921. In my cases, however, it appeared more frequently as one of the many dystrophies that occur further along the geneological line from an original syphilis.

STUDY OF MALOCCLUSION

It was while the above studies on missing lateral incisors and on dental defects in the generation after Hutchinson's teeth were in my mind that a certain fact obtruded on my attention: this was that a number of children whom I had sent to orthodontists for correction of malocclusion were members of the third or fourth generation of the various families whose dental history I was tracing. Since the etiology of malocclusion is still involved in great uncertainty, with a wide variety of ascribed causes, it occurred to me that cases of malocclusion in patients with whose dental history I was familiar might prove a fruitful subject of study. To trace a relationship of malocclusion found in these patients with the conditions of the teeth and jaws found in their brothers and sisters, parents, grandparents, uncles and aunts, and even cousins seemed to offer a possible source of light on the etiology of malocclusion by revealing underlying family factors.

Johnson[3] says: "It has been said that heredity need not be considered in orthodontia. It seems to me that to ignore the fact of heredity in any study

of development, normal or abnormal, is not consistent with modern thought. Even though we grant today that there is no inheritance of malocclusion, to dismiss the question of heredity, because of this, would be to leave out material that constitutes an essential part of the foundation of dental science in the study of development." And again, "There is reason to suppose that conditions which predispose to deformities are transmitted. This would be an instance where the chromosomes had been influenced by factors, such as disease-producing organisms, toxins, internal secretions, etc. The germ of syphilis is transmitted, hence the effect of syphilitic infection will appear in the offspring, and the disease being characterized by certain specific lesions and manifestations, the offspring will naturally develop conditions resembling the parents. In a more obscure way, the same is probably true of toxins and internal secretions which affect the germ cell."

As regards heredity, in my personal experience I have rarely seen any one particular dental lesion "passed on" from a parent to a child. I have, however, long noted two striking things: (1) In certain families the repeated appearance from generation to generation, in many instances three, and sometimes even four, of good teeth, generally similar in form, size, color and consistency; and (2) in certain other families of the same social status and exercising the same dental care, the repeated appearance in one generation after another of a tendency to dental dystrophy, which followed no particular pattern but exhibited itself in a variety of ways. The impression gained is that families in which good teeth predominate from one generation to the next are free from certain constitutional influences, as syphilis, tuberculosis, or the deficiency diseases, while, on the contrary, families in which dental dystrophies regularly appear, are among those in which underlying constitutional disability tends to affect the teeth.

If this is true, the study of malocclusion as a family phenomenon should give a clearer idea of its etiology than studies on isolated cases. If we know the characteristics and peculiarities of the teeth and jaws of all the children in a family and compare these, by actual observation, with those of the parents and all other possible relatives; if we can note in families with several children whether one child will present malocclusion in contrast to excellent conditions in the other children, or whether malocclusion in one child is balanced by other defects in its brothers and sisters, then it may be possible to evaluate family factors affecting growth and development.

Personal Observations.—Fifty-six cases of malocclusion are here reported on, chosen because in every instance I knew something of the family dental history. As many as five or six cases have occurred, in some instances, in two or three generations of the same family.

Of these 56 cases, many fall roughly into Angle's Class II; many are complex. I have, however, merely indicated their more salient characteristics by grouping them under the headings of (1) crowded teeth, 17 cases; (2) open-bite, 26 cases; (3) extreme prognathism, 3 cases; (4) slight malalignment, 10 cases. Frequently these types overlapped, as for example, a patient might have both crowded teeth and an open-bite; this grouping is used simply for convenience.

SUMMARY OF DENTAL COMPLICATIONS IN 56 CASES OF MALOCCLUSSION

1. Malocclusion occurred in association with Hutchinson's teeth in 8 patients; 6 of these also had open-bite; the 2 others had extreme prognathism. One of these in addition had both maxillary lateral incisors congenitally missing. In these 8 cases malocclusion was undoubtedly part of the dental expression of congenital syphilis. Dr. A. Benson Cannon[4] has noted malocclusion in congenital syphilities, as have also d'Alise[5] and Watry.[6]

2. Malocclusion occurred in 25 patients whose close relations (grandparents, parents, brother or sister) had typical Hutchinson's teeth. Seven of these patients had open-bite; twelve, crowded teeth; and six, slight malalignment.

3. In the remaining cases: 2 patients had a history of defective teeth for three generations on the paternal side, with the paternal grandfather a known syphilitic. Two patients had a family record of hypoplasia near the incisal edge and spacing of the incisor teeth for three generations. Two other patients came from families characterized for three generations by spaced incisor teeth, hypoplasia and microdontism. Seventeen cases were in patients, members of whose families showed, variously, congenital absence of the lateral incisors or peg-shaped lateral incisors; hypoplasia; spaced teeth; and microdontism.

In all the cases of malocclusion which I have seen where I have known anything of the family dental history there was not one which did not show dental abnormalities on at least one side of the family in the preceding generation or generations. This applies to the cases in which the defect consisted of relatively slight malalignment of well-formed teeth, as much as it does to cases in which defects of the teeth and jaws were extreme.

To give a clearer picture of the dental background of some of these patients with malocclusion, several family groups are here detailed. It must be understood that I have seen personally in my office all these people reported on, and in a number of instances have x-ray pictures and models of their conditions. The term here used of "1st Generation" refers to the oldest generation of a family seen by me.

CASE 1

1st Generation:

Paternal grandfather: Hutchinson's incisors, widely spaced; congenital absence of right lateral incisor (Fig. 1).

Paternal grandmother: well-formed teeth.

2nd Generation:

Father: pitted maxillary incisors—transitional Hutchinsonian form (Fig. 2).

Father's brother (1): both maxillary lateral incisors congenitally missing (Fig. 3).

Father's brother (2): spaced central incisors (Fig. 4).

Father's brother (3): malocclusion; open-bite; spaced maxillary teeth (Fig. 5).

Mother: good teeth.

3rd Generation:

Son: malocclusion. Good teeth in malalignment; diagnosed as Angle's Class II, div. 1, like Fig. 6.

CASE 2

1st Generation:

Paternal grandfather: Hutchinson's teeth.

Paternal grandmother: excellent teeth.

2nd Generation:

Father: malocclusion; crowded teeth; speech defect; no open-bite.

Father's brother (1): both maxillary lateral incisors congenitally absent.

Father's brother (2): malocclusion; crowded teeth.

Father's sister: malocclusion; crowded teeth.

Mother (and her brothers): well-formed teeth.

3rd Generation:

Daughter: malocclusion diagnosed as Angle's Class II, div. 1; responded well to orthodontic treatment (Fig. 7).

CASE 3

1st Generation:

Paternal grandfather: Hutchinson's teeth.

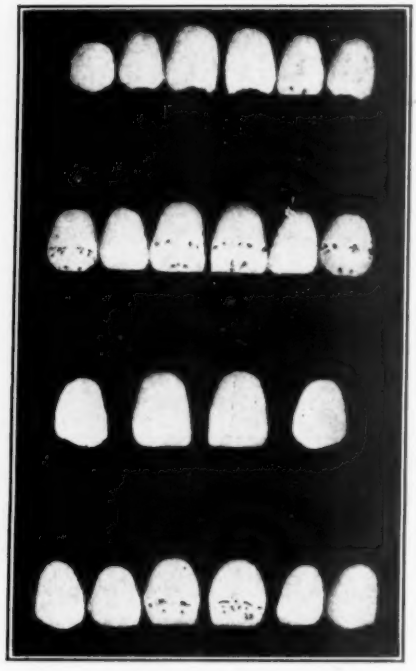

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

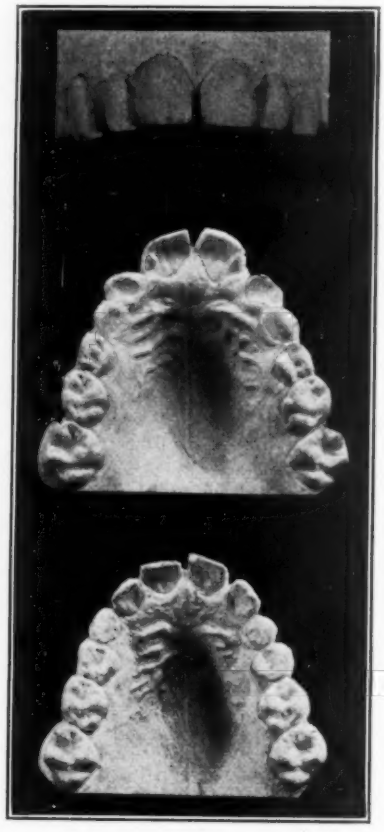

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 1.—Hutchinson's incisors, spaced, slightly turned on axes. Congenital absence of the right lateral incisor. Narrow high arch.

Fig. 2.—Pitted maxillary incisors. Transitional Hutchinsonian form.

Fig. 3.—Congenitally missing lateral incisors; spaced central incisors.

Fig. 4.—Spaced central incisors, bell-shaped.

Fig. 5.—Spaced central incisors with open-bite.

Fig. 6.—Cast of orthodontia case. Good teeth in malalignment. High arch.

Fig. 7.—Orthodontia case. Class II, div. 1.

2nd Generation:

Father: spaced maxillary central incisors; teeth otherwise well formed and well placed. (Certain French syphilologists term such centrally spaced incisors "Gaucher's sign," and regard it of value in the diagnosis of congenital syphilis. For American literature on this subject, see Roberts.[7])

3rd Generation:

Son: malocclusion; normal, well-formed teeth in malposition; diagnosed as Angle's Class II. Responded well to orthodontic treatment.

CASE 4

1st Generation:

Paternal grandfather: syphilis.

2nd Generation:

Father: both maxillary lateral incisors congenitally missing (x-ray confirmation). Like Fig. 3.

Father's brother: Hutchinson's teeth; malocclusion; open-bite. Like Fig. 8.

Father's sister (1): congenitally missing right lateral incisor.

Father's sister (2): peg-shaped lateral incisors.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 8.—Open-bite, malocclusion, Hutchinson's teeth.

Fig. 9.—Well-formed, crowded teeth with open-bite.

Fig. 10.—Very crowded, well-formed teeth; congenitally missing right lateral incisor; prognathism.

3rd Generation:

Daughter (1): malocclusion; good teeth out of alignment; Angle's Class II; well corrected.

Daughter (2): spaced maxillary central incisors; peg-shaped left lateral incisor.

CASE 5

1st Generation:

Paternal grandmother: Hutchinson's teeth; mulberry molar; malocclusion; open-bite. Like Fig. 8.

Paternal grandfather: malocclusion; normal teeth with open-bite. Like Fig. 9.

2nd Generation:
Father: very crowded well-formed teeth; prognathism; right lateral incisor congenitally absent; cuspid inside the arch (Fig. 10).
3rd Generation:
Son: malocclusion; well-formed teeth, crowded, but in much less degree than father's.
Note: malocclusions here occurred in three generations: both grandparents with open-bite; son and grandson, both with crowded teeth, but no open-bite.

CASE 6

1st Generation:
Paternal grandmother: Hutchinson's teeth.
2nd Generation:
Father: pitted teeth—transitional Hutchinsonian form—like Fig. 2.
3rd Generation:
Son: malocclusion; open-bite; well-formed but spaced maxillary teeth; diagnosed as Angle's Class II, div. 1; responded well to orthodontic treatment.

CASE 7

1st Generation:
Paternal grandfather: spaced central incisors (Gaucher's sign), like Fig. 11.
2nd Generation:
Father: pitted teeth (transitional Hutchinsonian form), like Fig. 2.
Father's brother: malocclusion; open-bite; spaced central incisors (Fig. 5).
3rd Generation:
Daughter: malocclusion; open-bite; diagnosed as Angle's Class II, div. 1; teeth well corrected (Fig. 6).

CASE 8

1st Generation:
Paternal great-grandfather: syphilis.
2nd Generation:
Paternal grandfather (son of above): excessive pyorrhea; all teeth fell out.
3rd Generation:
Father: normal teeth.
Father's sister: malocclusion and malformed arch; pronounced left-sided asymmetry with erosions of the incisors in the same location as Hutchinson's markings.
4th Generation:
Daughter: malocclusion; open-bite; Angle's Class I.
Son: all spaced incisors, like Fig. 12.
Father's nephew (son of sister with malocclusion): peg-shaped incisor (this boy's father had well-formed teeth).

CASE 9

1st Generation:
Maternal grandmother: congenitally missing maxillary left lateral incisor.
2nd Generation:
Mother: congenital agenesia of a maxillary lateral incisor.
Mother's brother: Hutchinson's teeth.
Father: normal teeth.
3rd Generation:
Son: malocclusion; very crowded teeth; open-bite; very abnormal.
Mother's niece (daughter of brother with Hutchinson's teeth): pitted teeth; lesser Hutchinsonian form. (This girl's mother and mother's sister had well-formed teeth.)

CASE 10

1st Generation:

Maternal grandfather: spaced central incisor teeth (Gaucher's sign), like Fig. 11.

Maternal grandmother: well-formed teeth.

2nd Generation:

Mother: distinct hypoplasia of all teeth; microdontism; erosions; deciduous teeth retained.

Mother's brother: all spaced incisor teeth, like Fig. 12.

Mother's sister: all spaced incisor teeth, like Fig. 12.

Father: well-formed teeth.

3rd Generation:

Daughter: malocclusion; open-bite; well-formed teeth in malposition; Angle's Class II, div. 1; well corrected.

CASE 11

1st Generation:

Paternal grandmother: retained deciduous teeth; high narrow arch; speech defect.

Fig. 11.

Fig. 12.

Fig. 11.—Spaced central incisors. Well-formed teeth showing no other lesion but the central spacing (Gaucher's sign).
Fig. 12.—All incisors spaced.

2nd Generation:

Father: spaced central incisors (Gaucher's sign), like Fig. 11.

3rd Generation:

Daughter: malocclusion; open-bite; good teeth; Angle's Class II, div. 1; well corrected.

In addition to showing dental relationships from one generation to the next, this family grouping gives the opportunity in eleven instances of comparing the teeth among children of the same generation. Among the 31 people forming these 11 groups of brothers and sisters, 15 of them had malocclusion and 15 others had other dental conditions fully as serious. For example:

A. In one group of five children, four had malocclusion with crowded teeth; one had also a speech defect; another, hare-lip. The fifth, without malocclusion, had both maxillary lateral incisors congenitally missing.

B. In a group of four children, one had malocclusion, with open-bite and spaced maxillary teeth. His three brothers had, severally, congenital absence of the maxillary lateral incisors; spaced central incisors; and hypoplasia of the maxillary incisors in the form and location of Hutchinson's teeth.

C. In another group of four, one had malocclusion in combination with Hutchinson's teeth; his sisters and brother had, severally, congenital absence of both maxillary lateral incisors; congenital agenesia of the right lateral incisor; and peg-shaped lateral incisors.

Furthermore, similar abnormal conditions or patterns prevail in totally unrelated families, as for example:

Family 10:

1st child: spaced central incisors; high arch; lisp (Fig. 11). Diagnosed as Angle's Class II, div. 1; slow in responding to orthodontic treatment.

2nd child: crowded teeth like Fig. 9, but no open-bite.

Family Z:

1st child: spaced central incisors, like Fig. 11.

2nd child: crowded teeth and open-bite (Fig. 9); slow in responding to orthodontic treatment.

In no case herein reported can malocclusion be regarded as an isolated phenomenon. It is invariably part of an expression of family dental disability, which can express itself in five different ways in as many children, and from which practically no child in these families escaped. These facts signify that more deeply underlying factors than local causes, vicious habits, or childhood exanthems, however much the latter may have contributed or complicated, were responsible for these cases of malocclusion. They point rather to a pathologic family background, which in several of these groups was undoubtedly a syphilitic one. It must be understood that in individual patients with malocclusion, of whose family dental history I knew nothing, I could not make any similar statements. The point which I am trying to bring out is that any consideration of the etiology of malocclusion is extremely difficult without a knowledge of family dental conditions or family pathology.

This report, taken as a whole, must be considered encouraging. In most of the children of the youngest generation (of whom I sent a number to orthodontists), the condition of the teeth, without relation to treatment, showed improvement over the condition noted in the parent and his family. It should be observed that invariably the heavily deforming cases of malocclusion, with overbite, sometimes in combination with Hutchinson's teeth, occurred in an earlier generation than the milder cases of malocclusion of well-formed teeth. In a former article, children of parents with Hutchinson's teeth were noted as being very diversely, but on the whole, less seriously marked than their fathers or mothers. In cases where the teeth are affected in families with, presumably, a syphilitic background, there is an apparent natural tendency toward dental regeneration, unless conjugal union takes place between members of two badly marked families. Since the fundamental "tendency for the human organism is to maintain its normal physico-chemical

condition and restore it when disturbed," it is natural that syphilitic toxins should become attenuated and the calcium metabolism be improved.

The cases of malocclusion that I have seen in combination with Hutchinson's teeth have usually been extreme; these cases are difficult to treat, and no ideal results can be expected. Lesser degrees of malocclusion, such as I have seen in the children and grandchildren of heavily marked individuals, have, on the contrary, responded excellently to orthodontic treatment.

General Considerations.—"The problem of luetic changes of the teeth is handled by dentists in a very stepmotherly fashion" (Madarász[8]). If this is true in Europe where dentists and syphilologists have combined to do considerable work on dental luetic stigmas, how much more true it is in the United States where, one gains the impression, dentists combat any knowledge of these changes and would even deny their existence.

Mr. A. T. Pitts, D.S.O.,[9] in a discussion of oral manifestations of congenital syphilis in children, has said: "The dentist with his narrow specialized training tends to regard the mouth from the standpoint of the teeth only, and in so doing sometimes overlooks the fact that conditions affecting his special province may be due to non-dental causes. On the other hand, the medical practitioner confronted with the more unusual sequelae of dental disease, even sometimes with its common sequelae, may be handicapped by a lack of knowledge of dental pathology. . . . If it were possible to pool our knowledge and experiences I am certain that pathology, dental and general, would be the richer."

CONCLUSIONS

In this paper and the two preceding it, I have tried to show that injuries to the teeth in families with a syphilitic background do not disappear with the generation showing heavy markings, such as Hutchinson's teeth, but tend to reappear, usually in lessening intensity, in children and grandchildren. Many conditions, such as malocclusion, spaced teeth, peg-shaped teeth, pitted and eroded teeth, etc., if they can be studied in patients in relation to their family dental histories, will often lead to revelation of similar conditions in other members of the family, and frequently to more heavily marked conditions in the preceding generation or generations. Malocclusion regarded in relation to family constitutional conditions—syphilitic or otherwise—takes on an unsuspected significance.

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METALLURGY AND USES OF CHROME ALLOY IN ORTHODONTICS

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FOR the past two years chrome alloy has created a vital interest for all people concerned with orthodontics. There has been much discussion for and against the material. We, who pioneered in its use, found it very difficult to obtain accurate and scientific data in respect to its reaction in our particular specialty. Our only recourse was to take the manufacturers' claims for its corrosive resisting properties and place a few test cases of the material in the mouth. This form of experimenting brought out its many advantages as well as its disadvantages. These were paired against each other and brought us to the conclusion that stainless steel (or chrome alloy, the preferred or accepted name) has three major advantages: exceptionally high tensile strength, a great amount of elasticity, and corrosive resisting properties. No metal up to the present time has presented these major advantages to such a high degree. Our problem then was to devise a standard and usable technique. In an article published by Dr. Brusse and myself in the International Journal of Orthodontia, Volume 20, No. 4, a brief résumé of the history of chrome alloy was given.

Stainless steel falls into two major groups. There is the chromium alloy steel or the magnetic type, and the chromium nickel or the nonmagnetic type. In these two groups there are a number of types different in chemical composition, all of which are not adaptable for orthodontics. All references in this article will be made to the 18-8 series of chromium nickel steels—nonmagnetic. This alloy contains 18 per cent chromium, 8 per cent nickel, and less than 0.15 of 1 per cent carbon; the rest of the alloy is made up of iron. This material is known as an austenite, is nonmagnetic, and cannot be hardened by heat treatment.

The metal has a peculiar property, its rapid increase in strength and hardness upon cold working. With these properties in mind a technique must be devised to take advantage of the physical properties of the metal. This will be given in detail in the succeeding paragraphs.

There is no single metal found in nature, not even gold or platinum, which is unaffected by corrosive attack in all environment, and no alloy has been developed with the exception of chrome alloy and the Stellite materials, that stands up in such perfect condition in the mouth.

In the ordinary types of 18-8 series of chrome alloy, microscopic examination will find that the metal exposed to heat ranges of 1000° F. to 1600° F. has darkly etched grain boundary. This appearance can be easily recognized and

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may serve as a warning of intergranular attack. This may be seen in the gross speciman; particularly where there are soldered joints or annealed areas, there will be a slight amount of corrosion. This depletion of chromium presents a vulnerable condition to the corroding medium, permitting ready attack which in some cases may be so severe as to cause complete disintegration of the alloy. Disintegration may occur in the metal adjacent to the weld or soldered joint when the entire piece has been subjected to an intermediate temperature of 1000° F. to 1600° F., or it may be general or over the entire piece.

The above described phenomenon is characteristic in all straight chromium nickel, austenitic stainless steels of chrome alloy. It has been determined, however that incorporation in the alloy of a straight carbide forming element, such as titanium or columbium, together with a suitable heat treatment, will completely immunize the alloy from this intergranular deterioration. The stabilized alloy is not damaged by heat treating in the temperatures ranging from 1000° F. to 1600° F. where the regular 18-8 alloy may have its corrosion resistance

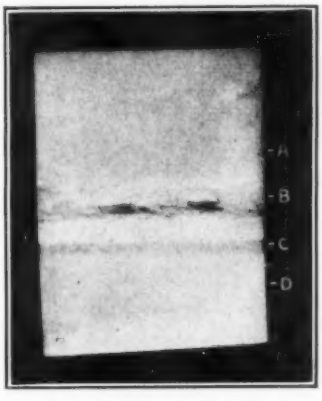


Fig. 1.—*A*, Stabilized chrome alloy; *B*, electric weld joint; *C*, intergranular deterioration; *D*, ordinary stainless steel.

seriously impaired. All alloys used in our practice for the last three years have been of the stabilized variety. (Fig. 1.)

Dr. Harry Wright, of Philadelphia, introduced me to the first soldering of chrome alloy. This was accomplished by the use of a potassium fluoride flux. The first appliances we attempted to solder were stainless steel lingual arches; to these arches gold auxiliary springs and precious metal posts were soldered. This technique worked very satisfactorily, and very little breakage was manifest. This was due to the fact that large bulks of solder were used around the chrome alloy arch. The higher fusing solders were used for this technique, mainly sixteen carat. The next step was naturally the complete assembling of the chrome alloy arch with auxiliary springs and posts. It was necessary to use a lower fusing solder, and our only alternative was to drop to a ten carat solder to solder auxiliary springs successfully and not draw their temper. A certain percentage of these soldered joints broke down in the mouth. This breaking down took place from three weeks to six months and was due, not to the galvanic action as we first thought, but to the fact that the mechanical union, similar

to that of a soft soldered joint, broke away from the base wire. This breaking was caused by a black carbide formed during soldering operations which prevented the solder from penetrating into the pores of the chrome alloy. (Fig. 2*B*.)

To prove this point to our minds, certain joints soldered without flux and with the same carat of solder in a hydrogen atmosphere, showed a union where the solder actually penetrated into the pores of the metal. (Fig. 3*B*.)

To prove these statements, laboratory tests were run in the following manner: Salt solution kept at a steady temperature of 85° F. was sprayed on the soldered joints. The soldered joints on which potassium fluoride and fourteen carat solder were used broke down in three to six days. Joints soldered with fourteen carat solder in a hydrogen atmosphere with no flux have stood up

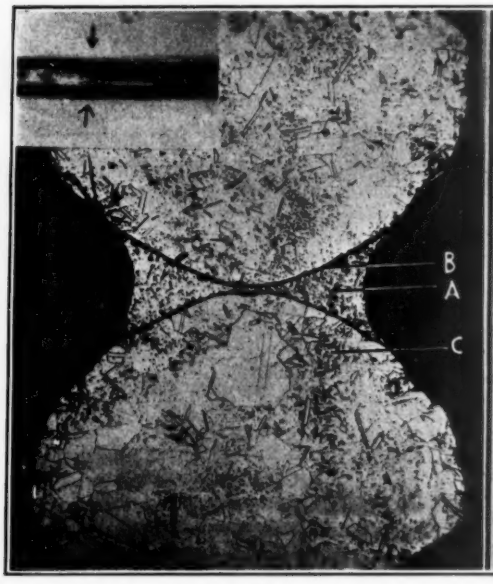


Fig. 2.

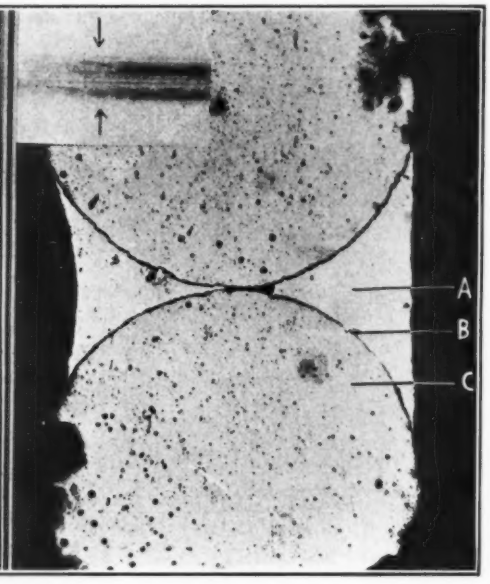


Fig. 3.

Fig. 2.—*A*, Solder; *B*, space between solder and chrome alloy (note large space); *C*, chrome alloy.

Fig. 3.—*A*, Solder; *B*, irregular space between solder and chrome alloy (note how solder penetrates into the chrome alloy); *C*, chrome alloy.

indefinitely. These tests were checked again in the mouth with identical joints placed on opposite sides of the mouth. Flux was used on one, while the other was soldered in a hydrogen atmosphere. The first joint broke down in four months. The joint in hydrogen atmosphere was good after one year and six months when the appliance was removed. This proves conclusively that it is not galvanic action that breaks down the soldered joints. If it were galvanic action, then it would make no difference whether the joints were soldered by flux or in a hydrogen atmosphere. These tests prove why it is impractical to solder chrome alloy.

Tests carried on independently and with the Smedley Dental Group of Denver, using a microammeter, have shown that there is a considerable amount

of galvanic action in the mouth. Papers by Lain and by Bernard L. Hyams of Montreal, Canada, show some very interesting electric galvanic tests of the mouth. Thinking this to be a vulnerable place to attack chrome alloy, the gold manufacturers and those men condemning the material have used this point on which to attack it. They have done this without investigating the actual compatibility of chrome alloy to other various metals used in the mouth. This is an attempt of these men to base their condemnations on logic rather than on the study of the natural phenomenon of the material.

In retrospect I should like to compare the position of this stand by the men condemning the material to that of the old scholars as referred to in Barnes' articles on the historical background and standing of the philosophy of Francis Bacon. He says, "In the year of our Lord, 1432, there arose a grievous quarrel among the brethren over the number of teeth in the mouth of a horse. For thirteen days the disputation raged without ceasing. All the ancient books and chronicles were fetched out, and wonderful and ponderous erudition, such as was never before heard in this region, was made manifest. At the beginning of the fourteenth day, a youthful friar of goodly bearing asked his learned superiors for permission to add a word, and straight way to the wonderment of the disputants, whose deep wisdom he sore vexed, he beseeched them to unbend in a manner coarse and unheard of, and to look into the mouth of a horse and find answer to their questionings. At this, their dignity being grievously hurt, they waxed exceeding wroth, and joining in a mighty uproar, they flew upon him and smote him hip and thigh, and cast him out forthwith; for as they said Satan has tempted this bold neophyte to declare unholy and unheard of way of finding truth contrary to all the teachings of the fathers. After many days more of grievous strife, the dove of peace sat on the assembly and they as one man, declaring the problem to an everlasting mystery because of the dearth of historical and theological evidence thereof, so ordered the same writ down."

Tests carried on in the mouth have proved conclusively the low electro-galvanic action of chrome alloy. One manufacturer went so far as to claim that due to the severe irritation of the tissues of the mouth chrome alloy was causing cancer in the mouth of many young patients. I offer Table I to show the absurdness of such statements. These figures are corroborated by both Dr. Brusse and myself, and further tests were carried on in the Smedley Dental Group of Denver.

The article of DeCoster and Friel shows the technique of spot welding various forms and types of orthodontic appliances using stainless steel as their metal. These men showed clever ingenuity in mastering their own particular techniques in how to overcome the difficulties in fabricating chrome alloy or stainless steel. Dr. Brusse and I have borrowed freely from the technique of these men to perfect ours.

I am going to take the liberty of repeating our technique of fitting molar bands as published in our former article: "We use seamless bands made of

stabilized chrome alloy. These bands are beveled at the occlusal one-fourth by spinning over steel dies. The dies are anatomical reproductions of molar teeth that have their cusps ground away to the level of the crest of the mesial and distal marginal ridges; therefore the beveled fourth of the band resembles that portion of the tooth above the bell. This natural shape limits the depth that the band can be forced toward the gingival. Excessive force will cause the band to take up the gingival slack at the mesial and distal and cause the band to fit more tightly. The only alteration necessary on the occlusal portion of the band

TABLE I

GALVANIC ACTION, IN MICROAMPERES

CASE NO.	PH.	AMALGAM				GOLD			AG. INLAY TO AG. INLAY	CHROME ALLOY		
		AMALGAM	GOLD	COPPER	AG. INLAY	COPPER	GOLD	AG. INLAY		SILVER	GOLD	AMALGAM
I	6.75	4	6		19			3	3	3	2	4
II	6.5	10	4		5					5	4	5
III	6.75	9	11		3		3	9	8	4	3	4
IV	7	8	19				4			1	1	2
V	6.8	18	15								4	5
VI	6.5	2	6				2				0	1
VII	6.3		3				7				2	1
VIII	6.8	3					2				0	1
IX	5.9						1				0	0
X	6.8	8	40				3				5	4
XI	6.5	2	3				4				1	1
XII	6.5	5	7				0				1	2
XIII	6.7	3									1	1
XIV	6.8	2	4		3		2	3	4		2	2
XV	7	6	11				2	9			3	4
XVI	6.8	3	4	14		18	2				1	2
XVII		5	10	15		20	7				5	2
XVIII		1					0				0	0
XIX		1										1
XX		2										1
XXI							3				2	
XXII		0	0								0	0
XXIII		3					4				1	4
XXIV		2	3				3				2	1
XXV		7	5				3				2	5
XXVI		3										2
XXVII		5	4	5		5	4				2	4
XXVIII		4	5				3				2	3
XXIX		3	4				3				2	1

is the placing of the lingual grooves on the upper, and the buccal grooves on the lower. Grinding and cutting are necessary only at the gingival portion to establish depth of the band. Care must be used not to have the band extend too far under the gingival tissue, as it will be difficult to remove after cementation.

"*Procedure for Fitting Maxillary Molar Bands.*—Bands are made in twelve different sizes. Select a band or proper size, one that will fit snugly over the bell of the tooth. Bend the band between thumb and forefinger until it assumes the rhomboid shape of either the right or the left molar. Place the band on the

tooth with the grooved surface to the buccal. Have the patient bite on a wooden tongue blade. The band can then be forced deeper by band adapters. Remove the band and trim around the gingival.

"After securing the proper length of band, crimp the band around the gingival to assure close adaptation at the neck of the tooth. When this has been done, the band can be forced over the tooth, where it will snap into place. (This cold working will add spring and hardness to the metal. Chrome alloy 18-8 will increase in hardness and elasticity from five to eight times by cold working.)

"The occlusal bevel of the band determines its length. Do not destroy this contour by grinding. The final and most important operation is seating the band. This is accomplished by use of the Eby band driver. This instrument must be used vigorously on the lingual portion of the maxillary band only, and the band must be driven to its limit to escape occlusion of the mandibular cusps. The band adapter is then used to form a lingual groove.

"*Procedure for Fitting Mandibular Bands.*—These bands are made in twelve different sizes also, but differ considerably in form from maxillary molar

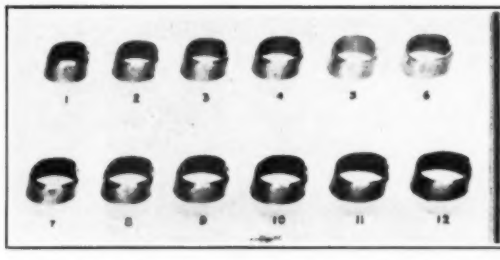


Fig. 4.—Seamless mandibular molar bands.

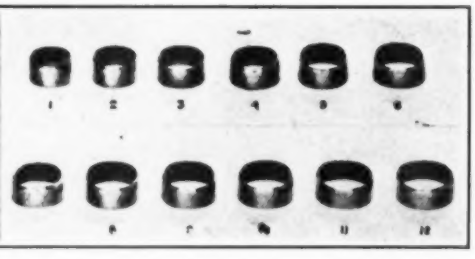


Fig. 5.—Seamless maxillary molar bands.

bands. They are cut at a twelve degree bias. The buccal surface is lower than the lingual. The lingual surface inclines inward toward the gingival. Mandibular bands are adapted in much the same manner as the maxillary bands. The surface containing the groove is placed to the lingual.

"Fig. 4 shows the seamless mandibular molar bands and Fig. 5 shows the seamless maxillary molar bands.

"Follow the technique for maxillary band fitting to the final seating of the band. From this point on, the only force necessary is the driving of the band into position by use of the Eby band driver. This driver must be used on the buccal surface only on the mandibular band. Place buccal grooves with the band adapter. The band on the buccal surface must escape occlusion of the maxillary teeth.

"The weakness of the seamless molar band technique results from two causes: the use of band forms that do not fit the anatomy of the teeth, and the lack of sufficient size range.

"The bands we use are designed from typical tooth forms secured from study of extracted teeth. Considerable thought has been given to the study of the mandibular series, and the design produced enables us to fit mandibular

molars more successfully than formerly, using other bands. While twelve graduated sizes are insufficient to cover the various sizes of teeth encountered, with the aid of band stretching pliers of the expansion bolt type with tips carved in the same shape as the bands, any number of intermediate sizes can be formed without destroying the shape of the band. This band stretcher expands laterally in four directions and is capable of enlarging a band two sizes. This not only gives us an unlimited size range, but proves invaluable when certain numbers are out of stock.

Fig. 6.—Band stretchers.

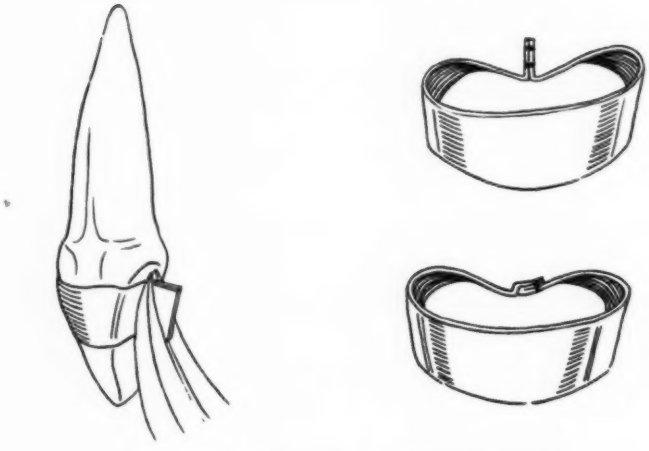


Fig. 7.—Construction of anterior bands.

"The stiffness and springiness of 18-8 alloy make this metal ideal for band material. In lingual arch construction, if solvite impressions are taken and stone models made, the bands can be removed from casts and cemented with the same accuracy as overlays, and the lingual arch may be placed in the mouth without alterations. We have never experienced this pleasure with gold platinum bands."

Fig. 6 shows the band stretchers.

In the construction of anterior bands, chrome alloy possesses physical properties that are far superior to those of any metal ever put before the orthodontic

profession. The metal is readily malleable, and it is possible to adapt it to the contours of the teeth and to repoduce the dental anatomy accurately. The metal cannot be hardened by heat treatment and is tempered only by manipulation or working. It is particularly suited for orthodontic band technique, because as the anterior band nears completion in its contoured stage it possesses a certain degree of temper which has been brought on through the manipulation of the metal.

To quote from Dr. W. R. Humphrey's paper read before the American Dental Association in New Orleans, "I must remind you that any material

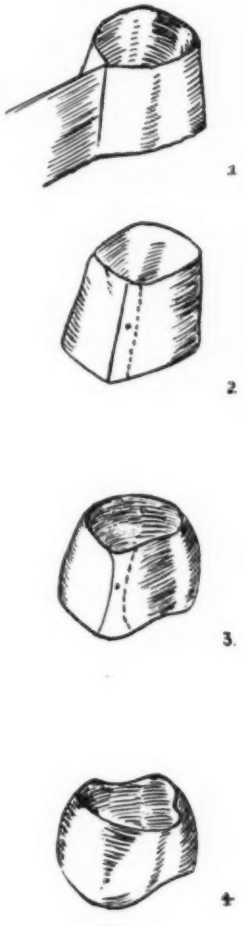


Fig. 8.

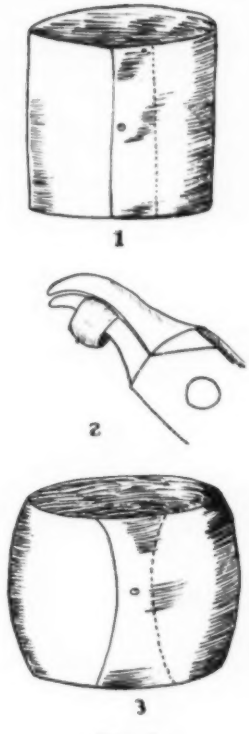


Fig. 9.

Fig. 8.—Construction of mandibular premolar bands.
Fig. 9.—Construction of maxillary premolar bands.

lends itself to the hands of the craftsman in two ways—it can be either crudely worked or fashioned into a thing of beauty." This is true of chrome alloy particularly in the construction of bands, anterior, bicuspid or molar.

In the construction of anterior bands I should like to present the following technique. In maxillary and mandibular incisors, the width of band material used is 0.125—0.15—0.17. The thickness used is 0.003 and 0.004. The latter width is used only on unusually large teeth. Bands are aligned by first making a pencil

mark and constructing them to this mark. After they have been pinched upon the lingual, the excess edges are welded together. This permits the replacing of the band to the tooth and the burnishing of the excesses on the lingual to the tooth. With this reinforcement it permits additional support to the band, so that in stress of mastication the band will not be worn through or dislodged. In this method the band is fitted accurately and there is no guesswork in placing the overlap seam. After the band has been burnished to the tooth, it can be removed and the flap spot welded down. This joint in the trade is known as the tinner's seam. (Fig. 7.)

In the construction of canine and premolar bands, Dr. Humphrey's technique is used: Fig. 8(*2*) is a plain cylinder welded with a spot midway between the top and the bottom of the cylinder. The cylinder is then contoured by contouring pliers, Fig. 8. This allows the metal to lap as is shown below.

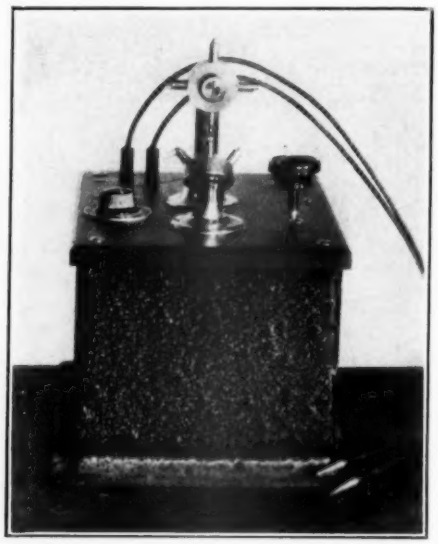


Fig. 10.—The spot welder.

This produces a contoured tube and the welding similar to a riveted joint. The same plan applied to the construction of a mandibular premolar band is shown in Fig. 9 from top to bottom: the pinch, the single welded spot, the contouring, and the finished and contoured band at the bottom.

Spot welding in orthodontics, along with many other arts, has been borrowed from the commercial world. It is now being used in practically every major factory in the United States, including the construction of airplane, automobile, and railway bodies. The greatest example of the use of stainless steel and spot welding is in the new high speed train, the Burlington Zephyr. The complete assembling of the body of this train was done by spot welding.

In orthodontia we are attempting to use the same procedure as in the commercial world, only on a much more refined scale. This is shown in the development of a highly specialized machine, Fig. 10. This spot welder has four distinct advantages: its variable heat control, the turret head, the pressure con-

trol, and the delicate manual operating switch. The turret head enables one to use many types of welding electrodes by simply rotating the head. With this particular machine a great amount of delicacy can be obtained on the individual weld. A stepped down transformer of low voltage and high amperage is used in this machine.

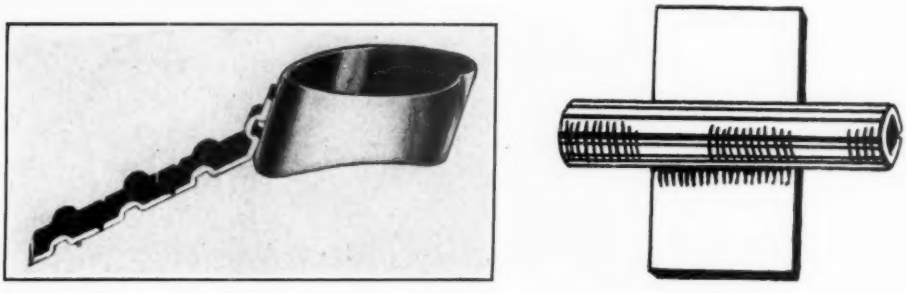
It might be well at this time to state just what spot welding really is. When two pieces of metal are spot welded, the electrical resistance of the metal to the electrical current is so great that it actually causes a fusing of the metals to each other. The spot welds are very small in diameter, so it is well to use numerous light welds rather than one heavy one. A good comparison of this would be the stitches of a sewing machine. When one large stitch is used to sew material together, the material is not so strong as that on which many small stitches have been used. This invariably holds true in spot welding.

Fig. 11.—Photomicrograph of a spot weld joint.

Spot welding depends upon four variables: the current, the diameter of the electrodes, the pressure, and the exposure. These variables must be paired one against the other to weld the materials satisfactorily. For example, in welding flat material of the same size, it is best to use a medium sized electrode, a very short exposure, and approximately twenty pounds of pressure. The higher the heat, the greater the pressure, the smaller the electrode, and the less time needed to allow the current to flow. In welding materials of different size it is better to use electrodes of different size, using the small pointed electrode against the larger wire and the large electrode against the smaller wire. In this type of welding minimum exposure time should be used with the proper amount of pressure. Theoretically spot welding can be obtained that will not change the molecular condition of the material if it can be timed to a two hundred and eightieth of a second. This is particularly true in spot welding auxiliary springs to the base wires, although this technique will be taken up in detail later.

The technique of spot welding must be learned by actual experience and use of the machine, not by reading a book on the subject. A good comparison of this would be swimming. Men who have taken a course in spot welding under the supervision of an expert are the ones who are successfully using the chrome alloy technique. Those who are trying to pick up the technique of spot welding by reading a book are not getting its full advantages. Let me state here that the spot welding of chrome alloy is not a substitute for the soldering of precious metals. It is a technique of its own, and those who have used both methods find spot welding a better technique in every way than the old method

Fig. 12.—Flanged lingual tubes, made in strips of twelve.



A. *B.*

Fig. 13.—*A*, Square flanged buccal tube spot welded to band; *B*, round flanged buccal tube for spot welding.

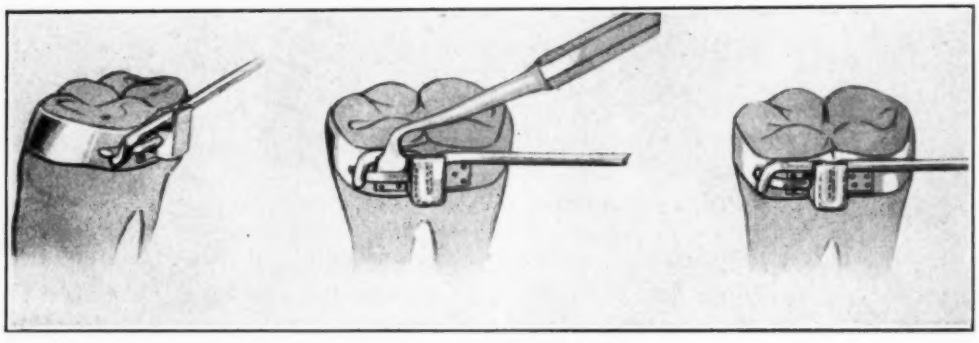


Fig. 14.—New lingual lock.

of soldering gold or precious metals. Fig. 11 shows a photomicrograph of a spot weld joint. Note the complete union of the two pieces of metal. The two wires are actually fused together.

The attachments that are used in spot welding are known as flanged attachments and may be used for either molar or anterior bands. The flanged lingual tube is an example, being a modification of the Ellis tube devised by Dr. Walter Ellis. The flange on these attachments extends to each side, and provides the necessary flat surface for the spot weld to the band. In placing the flanged lingual tube on the band, you put the attachment between the elec-

trodes, adjust it properly in position, and see that the flange is placed securely to the molar band, then weld it. This particular attachment comes in strips so that it is easy to align them in the proper position. (Fig. 12.) This can be accomplished by first making a single weld, rotating the attachment to the position you desire and then welding the flanges in place, using approximately six welds to a side.

In placing the flanged buccal tubes of Fig. 13, it is best first to make a single weld of the flange to the gingival of the band. Cut off the excess of the flange and carry it to the mouth and align it to the proper position. If the tube has been placed too far distally or too far mesially, tear the weld apart and proceed as you did before, using greater care to get it aligned properly mesial-distally. A single weld permits the adjustment of the occlusal gingival alignment so that it can be rotated properly to its position. After this is done, remove the band from the mouth and weld the flange securely with numerous spot welds.

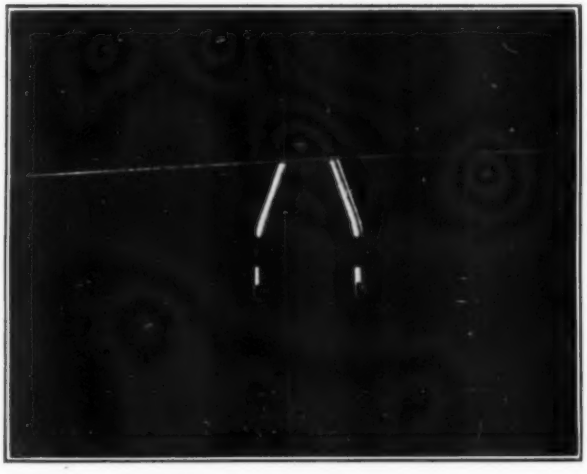


Fig. 15.—Annealing wire.

A new type of lock designed by Dr. Brusse and myself is shown in Fig. 14. This lock is made in the following manner. After the lingual tube has been spot welded in position, take a piece of 0.036 round wire and spot weld on the distal flange of the lingual tube approximately ¼" of the round wire. When the Ellis loop is bent, take the lingual arch and bend the distal part according to the figure.

In certain cases in which numerous anterior bands are used, it is better to use the narrower buccal tubes. These tubes vary in size according to the arch wire that is desired in the case. We find this tube less bulky and are therefore able to control the molars more satisfactorily when using it.

The Ketcham snap hook is welded in a manner similar to that of the flanged lingual tube. We feel that this attachment is one of the greatest developments that has been given to the orthodontic profession in many years. Its wide range of adaptability and its many uses make it a very valuable attachment. Technique of this attachment will be taken up later.

Again I should like to repeat part of our article on the construction of the Ellis arch. "A piece of 0.036 wire is annealed approximately two inches from the end of the wire, Fig. 15. Take the wire between the nose of the pliers and bend completely upon itself as in Fig. 16. Grasp the bent section (section bent with pliers) approximately one-tenth of an inch from the end, and force the ends of the wire to right angles as in Fig. 16*B*. To establish the depth of the Ellis loop place the wire in a hole in the Ellis wire bending pliers and press the pliers together, as in Figure 16*C*.

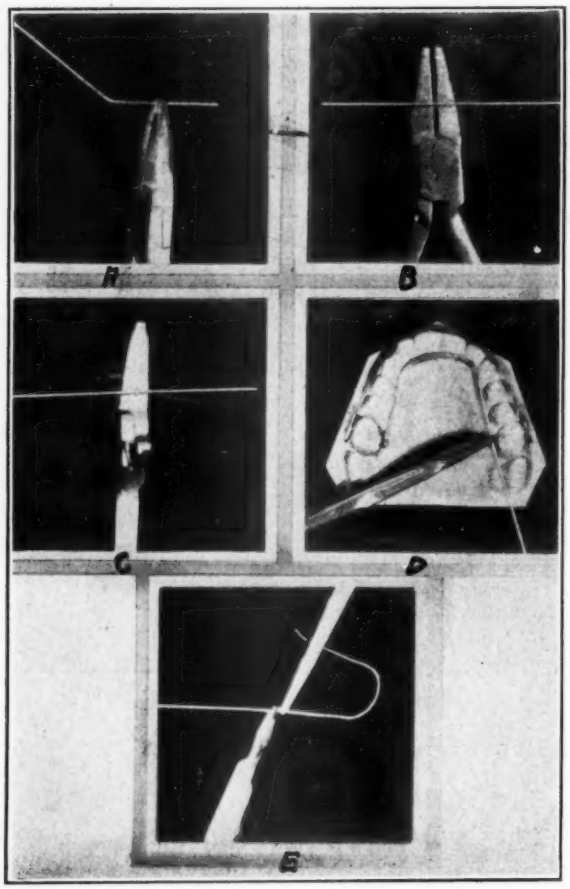


Fig. 16.—Technique of bending Ellis loop.

"Place the arch in the Ellis type tube on the left side of the model, and adapt the arch to the model with pliers and fingers approximately to the position desired. Holding the arch in position on the model, make a mark or attach a hemostat anterior to the Ellis tube on the opposite side, Fig. 16*D*. By the use of a locked hemostat it is possible to maintain the position that you desire the bend to be without scratching or marring the wire. Anneal posterior to this hemostat allowing the annealing point to come within one-tenth inch of the instrument. This can be done on the little annealing electrode on the back of the spot welder, Fig. 17.

"Holding the pliers posterior to the hemostat make a bend of the wire upward. Then release the hemostat and bend the wire backward upon itself, as in Figure 16-E. Now bend the arch, rather than the length of wire, downward in the same manner and proceed as you did on your first bend.

"Place the arch in the tubes. Then, with an electric arch adapter, as in Fig. 18, hold in place with adapter points, and with intermittent pressure on the foot pedal of the spot welder, adapt the arch to a passive stage on the model. Keep in mind that the arch must not be allowed to become hotter than a dull red (1290° F.). It is for the purpose of being able to see through the medium of our color range the amount of heat we are applying to the arch that the

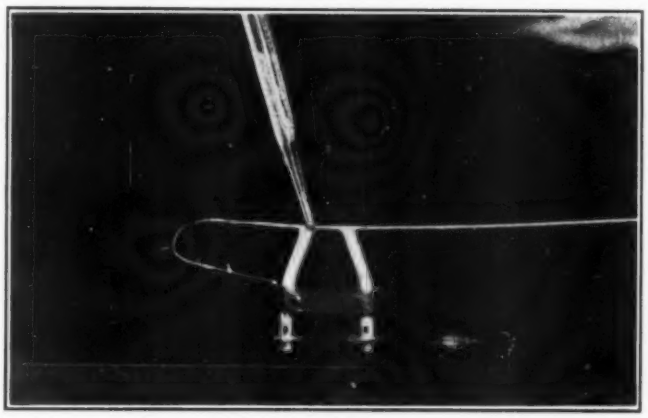


Fig. 17.—Annealing lingual arch for second Ellis loop.

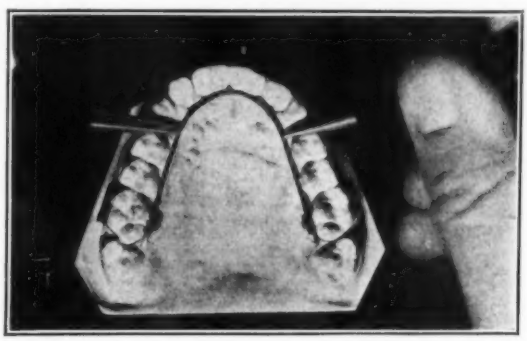


Fig. 18.—Adapting lingual arch with electric arch adapter.

electric arch adapter is used. When a flame is used for adapting the arch there is danger that annealing may not be uniform and that soft areas in the arch may result."

Technique of Attaching Auxiliary Springs.—Anneal 0.015 or 0.016 auxiliary spring wire one inch from the end with an area of one-half inch. This is done on the electric annealer similar to Fig. 16. Place the auxiliary spring wire on the base wire making sure that the large electrode approximates the small wire and the small electrode approximates the big wire. Make a single tack on low heat similar to Fig. 19-#1, with a minimum amount of exposure. Wrap the auxiliary spring wire twice around the lingual arch, and wrap in the

opposite direction to which you intend to extend the auxiliary spring, as in Fig. 19-#2. Take the excess tail and spot similar to Fig. 19-#3. Proceed with the bending of the auxiliary spring similar to Fig. 19-#4.

This is the method of attaching auxiliary springs, labial locks and some types of intermaxillary hooks.

Labial arches are generally made all in one piece. The first labial arches we used in the chrome alloy technique were large and bulky. We have since decreased the size of these arches from 0.040 to 0.016, 0.018, 0.020, 0.022, which we are now using. Very seldom do we use any larger size than those, although we sometimes drop down to an arch as small as 0.010 for labial arches. But in

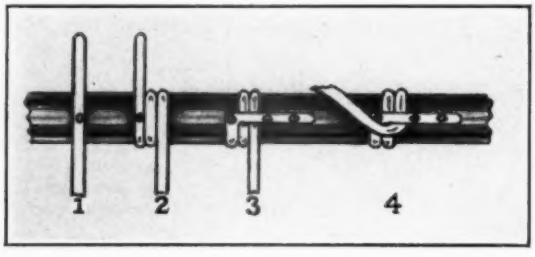


Fig. 19.—Technique for attaching auxiliary springs.

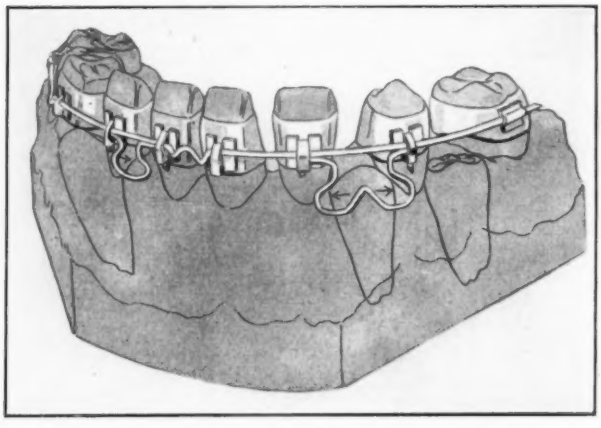


Fig. 20.—Method used in opening and closing spaces.

doing this we use two of the 0.010 arches. In using one piece labial arches in the small gauges it is necessary to bend the intermaxillary hooks to the arch. This requires a little ingenuity, but after you have once arrived at a technique for this, it is very simple and requires just a short time in which to accomplish it. When we use larger labial arches and want to put on intermaxillary hooks, we spot weld the intermaxillary hook to position similar to the method that we use in attaching auxiliary springs.

Recently we have been attempting a method of opening and closing spaces by using an 0.022 labial arch as a base arch and then using a sectional arch, or loop staple as we prefer to call it, for closing and opening these spaces. We have borrowed this idea from the technique of Dr. Spencer Atkinson in his universal brackets. You might say that it is the same principle as moving beads along on

a string. You will get an idea of what is meant from Fig. 20. The sectional loops are constructed of 0.010 or 0.015 wire. In this way we obtain a very delicate pressure and yet have a wire of very high resiliency, as you will note in the table. You will find that the higher the gauge wire, the higher the tensile strength.

The Bureau of Standards has sent the following values as a minimum for orthodontic wires:

Ultimate tensile strength	150,000 lb. per sq. in.
Yield point	125,000 lb. per sq. in.
Elongation (hard)	4 per cent in two inches.
Elongation (soft)	15 per cent in two inches.

(All values are minimum)

Comparing this with the size wires of chrome alloy that we are now using in orthodontics will give one an idea of the comparative value of these materials. You will note that the smaller the gauge wire, the higher it is in tensile strength and yield point. This list was furnished by the research department of the United States Steel Corporation.

TABLE II

SIZE	ULTIMATE STRENGTH LB. PER SQ. IN.	% ELONGATION 2"	YIELD POINT LB. PER SQ. IN.
0.008	326000	1 max.	270000
0.010	310000	1 max.	240000
0.015	308000	1-1.5	235000
0.018	309000	1 max.	240000
0.020	290000	1 max.	225000
0.022	290000	1 max.	225000
0.028	287000	1 max.	220000
0.030	285000	1 max.	220000
0.032	284000	1 max.	210000
0.036	274000	1 max.	210000

At this time I should like to quote Dr. LeRoy Johnson of New York City as guest speaker before the Rocky Mountain Society of Orthodontists some eight years ago. He said, "Authority has been lifted from a large part of the orthodontic world. We are going through a period of anarchy, introductory to a more intelligent understanding of our field of work. Not so very long ago, our thought was dominated by personal authority. We accepted all on authority. We were give a specific cause for every condition of malocclusion. Treatment was made nearly a matter of classification and the use of a certain type of appliances. Cases were designated as class one, two, or three; a fee demanded and treatment begun with the same assurance of success that a builder has in constructing the house you live in. We did not doubt, we knew, but experience has opened our eyes. Time has forced the cold reality of facts upon us. We have found that much of the so-called 'basic doctrine' is untrue and that the simplicity of the one, two, three method as a basis of diagnosis is a delusion. Today, we realize that much of the subject matter of modern orthodontics grew out of an attempted system of logic rather than from the study of natural phenomenon."

This quotation is similar to our feeling in the research we have done in chrome alloy. It has taken many years of hard work and study, and we have

received much condemnation on our work. We have been handicapped by propaganda forced upon the dental profession not only by the commercial houses but by the personal opinion of the research men; although these same men stated that they had done very little work upon the base metals, particularly stainless steel.

In conclusion I should like to stress: First, chrome alloy has a very low galvanic action. Second, chrome alloy is not a substitute for gold, but is a superior metal to replace the precious metals. Third, the monetary saving of the material should never be considered in judging its qualities. Fourth, chrome alloy is workable and can be used successfully with no deleterious effects. Fifth, better bands, including molar, premolar, and anterior bands, can be constructed. Sixth, smaller arches with more accurate control can be used. Seventh, there is less danger to rapid movement which might cause root absorption, death of pulps, and severe bone atrophy.

ORIGINAL APPLIANCE FOR THE TREATMENT OF OPEN-BITE

Hinged Labial Arch Wire

Sidney P. Stone, D.M.D., Boston, Mass.

THE purpose of this paper is merely to present a new practical device for the mechanical therapy of open-bite. Therefore no attempt will be made to discuss the perplexing problem of open-bite with its complicated etiologic factors, treatment, and the unfavorable prognosis of a good many of these cases. Only brief reference will be made to some of the mechanical phases of the problem in dealing with the treatment of this type of malocclusion.

In reviewing some of the literature, from the early writings of Angle to the most recent publications, one may conclude that the problem of mechanical therapy of open-bite is still primarily one of anchorage. For example, in order to insure safety to the molar teeth, Angle advised slow action of the arch wire and frequent rest periods. With reference to his method of correcting infraclusion by means of his expansion arch, Angle issues this note of caution[1]: "This is an excellent method of correcting infraclusion of the teeth and yet it must not be forgotten that the force also tends to elevate the anchor teeth, and that they must not be overtaxed by the attempt to move too many teeth at once." Similar warning is imparted by Dewey and Anderson[2] regarding the use of labial appliance and intermaxillary elastics for the elevation of maxillary and mandibular incisors: "It is important to watch the stability of such appliances, for it is very easy to tip the molars, which will in turn have a tendency to open the bite." In a recent extensive paper on "Open-Bite" by Lucien de Coster, one finds that he holds similar views. Referring to the use of various arch appliances and vertical intermaxillary elasties, de Coster says[3]: "The unfortunate feature of all these appliances is that they burden heavily the anchorage molars and can misplace them." Thus it is evident that many appliances have a tendency to disturb molar relationships, unless extreme care and good judgment are exercised.

The choice as to type of appliance to be employed depends upon the operator's diagnosis; whether the open-bite is due to supraversion of the posterior teeth, or whether there is an infraclusion in the anterior region with a normal vertical relationship of the buccal teeth. If the latter is the case, the therapy depends upon the elevation of the anterior teeth. Among some of the methods used are labial appliances so adjusted as to produce a downward pull on the maxillary incisors and an upward pull on the mandibular anterior teeth. In

Résumé of clinics presented at the Seventy-Third Annual Meeting of the Mass. Dental Society, Boston, April 26-30, 1937; Annual Meeting of the Harvard Society of Orthodontists, Forsyth Dental Infirmary, Boston, May 26, 1937; and at the Seventy-Ninth Annual Session of the American Dental Association, Atlantic City, July 12-16, 1937.

some cases, these forces are augmented with intermaxillary elastics. E. A. Tisdale reports good results with his swivel tube technique, which was originally designed by L. W. Baker. Reenforced anchorage appliances with auxiliary springs for the elevation of incisors have been reported to give satisfactory results.

In cases in which open-bite is due to supraversion of the posterior teeth, the therapy depends on depressive forces of various types. Among some of the aids used are labial appliances with intermaxillary elastics in rectangular or triangular arrangement from canine to molar region which help to depress the posterior teeth and at the same time lengthen the anterior teeth. C. C. Howard uses a removable appliance with soft rubber on occlusal surfaces which brings about a depressive action on the molars through natural forces. Extraoral devices, such as head and chin caps of various types, are sometimes employed. Bite caps used

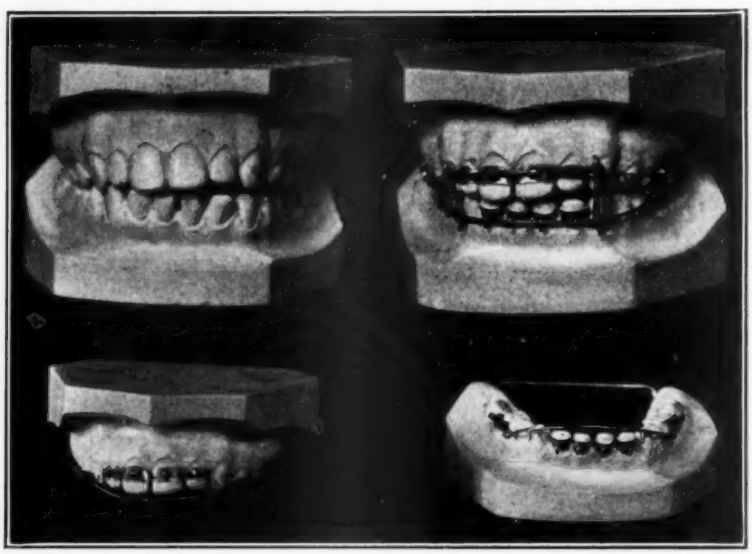


Fig. 1.—Demonstrating the hinged arch wire on casts. *A*, Models of an open-bite case. *B*, Duplicated casts with hinged arch wire operating with vertical intermaxillary elastics. *C* and *D*, Maxillary and mandibular models with hinged arch wires demonstrating gingivocclusal swing.

for some time will cause depression of molars, and when these caps are removed the bite closes. Occlusal grinding of molars and prosthetic methods are some other means utilized for correction of anterior infraversion. The discussion as to the merits or disadvantages of the various techniques is not within the scope of this paper.

I am now utilizing a "hinged" arch wire appliance for the correction of anterior infraclusion where there is a normal vertical relationship in the posterior region. This device is based on the principle of a free swinging joint in the arch wire, which is made just anterior to the mesial end of the buccal molar band tube; and from which point the arch wire will have "free play" occlusogingivally and thus will not disturb molar relationships whatever. Here, simple occlusogingival anchorage is transmitted through the arch wire (Fig. 1). This

method is practical, simple, and mechanically effective. All other corrections should be made first, including the elimination of pernicious habits, such as tongue and finger habits. When Class I arch relationship is reached, and only the anterior infraversion remains to be corrected, then the hinged arch wires with vertical intermaxillary elastics are employed. The teeth to be elevated are banded and a suitable attachment, such as bracket, Gove lock, Ketcham hook, McCoy's open tube, is soldered to each band for anchoring the arch wire. If

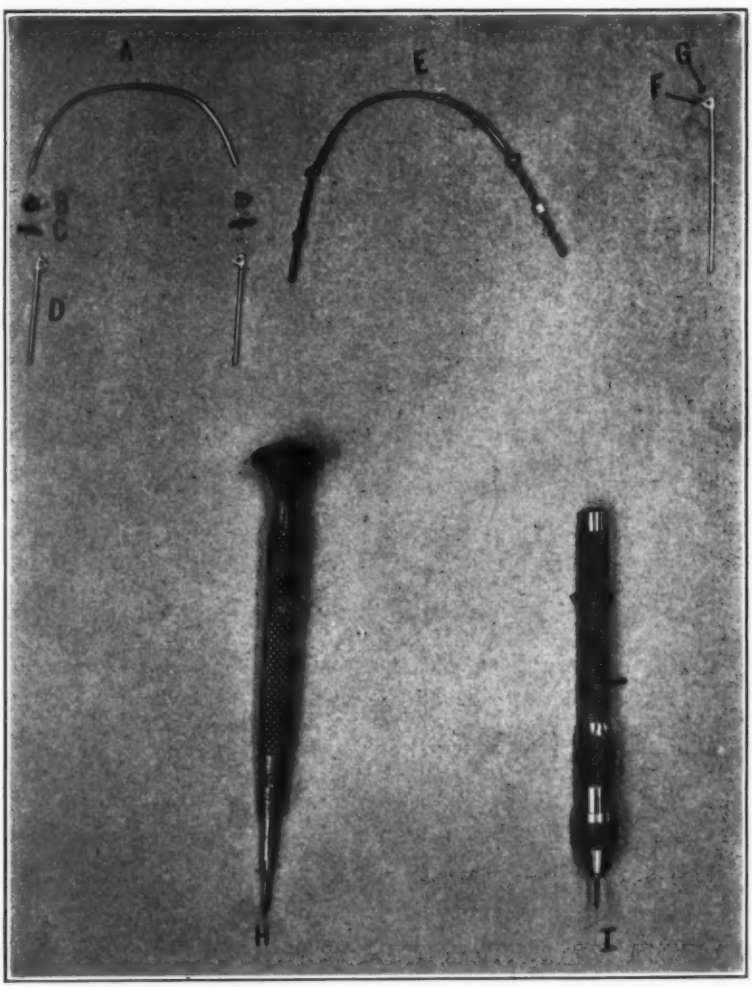


Fig. 2.—Parts of arch wire and instruments necessary for the construction of a hinged arch wire: *A*, section of arch wire; *B*, joint; *C*, screw; *D*, pin stem; *E*, assembled and completed arch wire; *F* and *G* indicate sharp angles in the head of the pin stem. After the arch is assembled, these angles are rounded out. The more the angles are rounded, the greater degree of free play the joint will have. *H*, Optical screw driver; *I*, tap holder and tap.

the maxillary and mandibular incisors require elevation, then the hinged arch wire is to be employed in both arches with vertical intermaxillary elastics. Thus the reciprocal action of the elastics brings about the desired elevation. If the elevation is required in one arch only, then the hinged arch wire is to be utilized in that arch only; and a fixed arch wire properly anchored in anterior bands is inserted on the opposing normal arch plus use of vertical intermaxillary

elastics. In this way, the normal arch offers a greater resistance because it is aided by added resistance of the molars. Therefore it makes a good anchorage against the hinged arch wire, thus producing elevation of the anterior teeth in that arch only. The anchor bands and tubes are placed in the usual way, and they merely serve as attachments for the hinged arch wires which can be readily removed and adjusted. The joint can be so constructed as to limit the free play by a stop in the pin stem; or if the angles of the head of the pin stem are rounded out, one can produce as much as 180 degree swing to the arch wire (Fig. 1). After the desired result is obtained, it does not become necessary to construct any retainers, because the hinged arch wire can be easily converted into a fixed wire by soldering the joint and thus becomes an effective retainer when made to lie passive in the attachment of the banded teeth in their newly corrected positions. On the subject of retention Angle said[1]: "The best means of retaining teeth so elevated is to allow the arch to remain in position the requisite time." The joint principle can be used with any type arch wire such as ribbon, edgewise, round, etc.

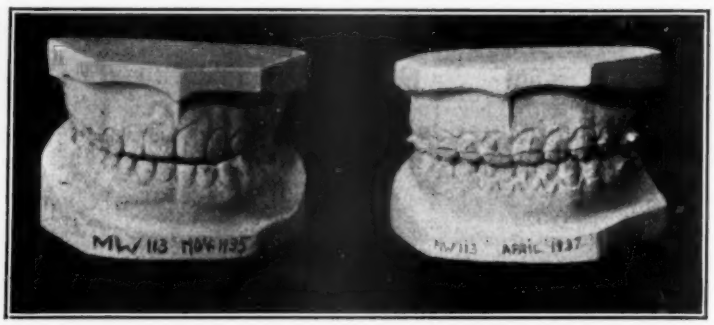


Fig. 3.—Left, casts at beginning of case, November, 1935. Right, progress models made from hydrocolloid impression materials, showing the infraclusion being corrected with the hinged arch wires, subsequent to the correction of the mesioclusion.

TECHNIQUE

The joint is easily constructed with the use of several simple inexpensive instruments. The requirements are a small screw driver (optical screw driver size), a tap for making threads, and a tap holder. The parts of the hinged arch wire consist of pin stems, joints, screws, and section of arch wire (Fig. 2). The pin stems and joints can be purchased in any jewelry house and are obtainable in any gauge, size, karat, etc. The screws and instruments are obtainable in optical supply houses. The screws which are of optical size usually are about 19 gauge and can be obtained in German silver, gold plated, or 10 karat. The tap should be of a corresponding gauge of that of the screws obtained. A broach holder makes a good substitute for a tap holder. When the joint is soldered to section of arch wire, then the pin stem "head" is gradually thinned out to fit into joint. The holes of the pin stem and joint are centered together, and the holes are gradually somewhat enlarged with a fissure bur until a 20 gauge wire will easily slide through. At this stage, the holes are threaded with the tap. The optical screws are now inserted; after which time the whole joint can be ground down to the desired size. The angles of the "head" of the pin stem are

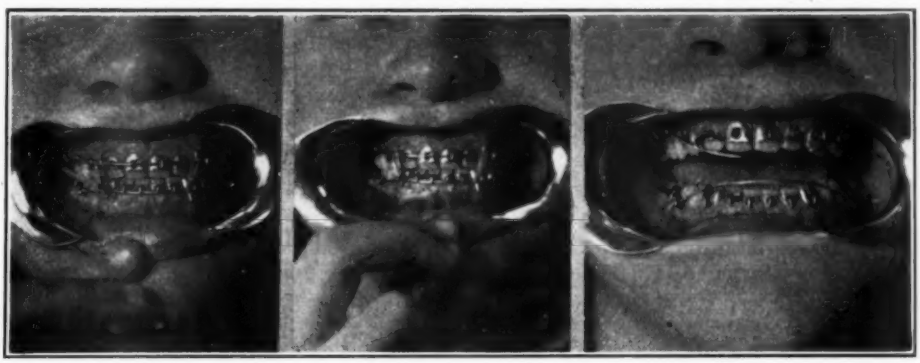
rounded out to the degree desired for free play gingivoclusally. It is suggested to those who wish to try it, to practice first with German silver joints, screws, and pin stems. After a little practice, the technique is easily mastered. Those who do not wish to use a tap and screw may substitute a wire. It should fit holes snugly and then cut off flush. A slight hammer blow will make the joint secure. The use of a screw for holding joint together is, however, to be preferred, because it makes a neater and stronger joint.

PRELIMINARY CASE REPORT

The patient, a girl, was about eleven years of age when she presented herself for treatment November, 1935 (Figs. 3 and 4). Patient was well developed physically and was in excellent health. Radiographs of the teeth revealed nothing unusual.

Diagnosis.—Mesioclusion case, associated with open-bite.

Etiology.—Probably heredity associated with finger-sucking habit. Upon examining family, mother was found to have Class III malocclusion.



A. *B.* *C.*

Fig. 4.—Photographs taken February, 1937, showing the practical application of the hinged arch wire: *A*, two sets of intermaxillary elastics, one to retain Class I relationship following the mesioclusion correction, and the other pair to elevate anterior teeth. *B*, vertical intermaxillary elastics only; *C*, showing gingivoclusal free play of the hinged arch wires anterior to the joints. Therefore no disturbance whatever has resulted to the anchor molar teeth.

Treatment.—First an attempt was made to correct the mesioclusion in the usual way until Class I relationship was established, which was accomplished in about a year. In the meantime the finger-sucking habits were gradually eliminated. About November, 1936, bands with Ketcham hooks were placed on the maxillary and mandibular six anterior teeth. Hinged arch wires were inserted, to which were attached hooks for vertical intermaxillary elastics for the purpose of producing elevation of the anterior teeth; hooks were also soldered to mandibular arch wire for intermaxillary elastics to maxillary molar buccal tubes in order to retain the Class I relationship. These elastics were worn nights only. The temporal-masseter exercises were also prescribed to help retention. The proper overbite was reached about April, 1937; after which time the vertical elastics were only worn several days a week. About July, 1937, the hinged arch wires were converted into fixed arch wires and are for the purpose of retention.

The hinged arch wires proved to be very effective in this case, and no disturbance whatever resulted to the anchor molar teeth.

I am utilizing this appliance in several other cases. A number of practitioners are beginning to put it to practical application. It is hoped that further clinical data will be available at some later date.

SUMMARY

The hinged arch wire offers the following advantages:

1. Simple gingivoclusal anchorage is obtained anterior to the joint; therefore there is no disturbance whatever to the anchor molar teeth.

2. Simple to construct.

3. The degree of free play of the joint can be controlled. This is accomplished in the technique of the construction of the joint. The more one rounds the angles in the pin stem, the more free play the joint will have. Thus it is possible to have a swing from 10 or 15 degrees to almost 180 degrees.

4. Arch wire can be made into an effective retainer by converting it into a fixed wire by soldering up joint, and then made to lie passive in the newly corrected positions of the teeth.

5. Adjustments are under easy control, because the simple gingivoclusal anchorage is transmitted through the hinged arch wire, which can be readily removed and adjusted.

6. The hinge can be constructed and utilized with any type arch wire such as round, ribbon, edgewise, etc.

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93 COLUMBIA ROAD

Department of Oral Surgery

Edited by

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IMPORTANCE OF EARLY DIAGNOSIS AND REMOVAL OF MANDIBULAR THIRD MOLAR

EARL U. SCHARFF, D.D.S., MEMPHIS, TENN.

YOU are all familiar with Dr. Winter's technique of delivering the impacted third molar in toto, and you have also practiced the removal of such teeth in sections; both techniques are attended with considerable trauma and after-pain.

In order to find a simple solution to this problem we began studying these areas in children. After securing many radiographs of young patients of varying ages and developments, we concluded that the best time to operate was before the crown had fully developed; if possible, when it had reached about 2 mm. in thickness. At this time, which is about twelve years of age or less, we obtain better cooperation from the patients. They can be assured that there will be no pain and that the procedure will be short.

My earnest plea is for early examination and diagnosis. When children whose parents, older brothers or sisters have a history of impacted third molars present themselves for examination, radiographs are necessary. Usually at the age of ten to thirteen years, depending upon the development of the child, only 2 mm. of the crown of the third molar will have developed; its positive inclination denotes the degree of impaction.

I believe it good practice, and a service unparalleled in dentistry, routinely to make bite-wing radiographs of children as early as you can get them to submit to the procedure. Begin at the age of six or seven years if possible, and repeat every six months thereafter until they have passed adolescence. In this way many abnormalities are discovered when their correction is less difficult.

It is not within the scope of this discussion to deliberate upon the early findings which would promote the health and well-being of the patient if relieved early in life. In a routine radiographic examination, however, young patients whose family history is positive in respect to impacted third molars, will often be found to be developing a similar condition. I have never seen statistics on the number of impactions in comparison to the number of patients

presented, but I would venture to say that it is at least 20 per cent. A technique as simple as that here described, with no detrimental influence attending it, though the procedure may seem radical and revolutionary, has its place in the hands of the general practitioner.

Preliminary medication of the patient consists of one and one-half grains of a semihypnotic and sedative drug by mouth, such as sodium barbital one hour before the operation. This is a great aid in handling young patients. Sterilize the field of operation in the mandibular third molar region and at the same time use a topical anesthetic so the patient does not feel the prick of the needle. In young patients it is necessary to go high in order to secure the mandibular block. No buccal injection is necessary because of the anatomy of the parts at this age. One injection takes care of the inferior dental, lingual and the buccal nerves. Use a 2 per cent novocaine cobefrin solution in a cartridge whose ends have been flamed for sterilization, and heated to body temperature. Use an all metal syringe and a very sharp 25 gauge rustless steel needle, 1⅝ inches long, which has been boiled twenty minutes. The anesthetic should be injected slowly, allowing the tissue to absorb the solution rather than forcing it in under pressure. I find this procedure attended with little or no immediate and subsequent pain, because it is less irritating to normal tissue. In three minutes, if the injection is correct, the field is anesthetized. With a sharp lancet, beginning in the middle of the buccal surface of the mandibular second molar at the gingival surface, make an incision one-fourth inch downward in a semicircle backward along the external oblique line about an inch; this will travel along the ascending ramus of the jaw. Do not be afraid to cut freely in this area because the tissue heals very quickly, and there is no danger attending this incision. Take a small periosteal elevator and lift the flap; expose the underlying area to the internal oblique line. Use a small delicate tissue retractor to expose the field of operation. With a very sharp semiround ronguer, remove the cancellous bone over the area. This is easily done because in the development of the tooth at this age the overlying cortical layer is very soft, and is sometimes entirely lacking. Nor has any alveolar bone been deposited around the bud at this early age because the sac of the developing third molar is very large, occupying the entire area of a fully developed tooth. It is only when the roots develop that the alveolar bone is simultaneously deposited in dense layers around these roots. This is one of the main reasons that delivery is more difficult at a later age. If the opening is large enough, the partially developed crown with its encapsulating sac can be gently and easily teased out. Make sure that all the crown and encapsulating developmental sac are thoroughly removed. Irrigate the socket under force, using a warm saline and soda solution. Bring the flap back into apposition, make one or two sutures engaging enough tissue so they will hold, use hot compresses inside the mouth on and around the wound (cotton rolls soaked in very hot soda, two parts, and one part saline solution), allow the compresses to stay in situ for five minutes. Instruct the patient to stay in bed one day with an ice bag on the outside of the face, applying it intermittently, thirty minutes at a time, for several hours after the effects of the injection wear off. Give a sedative if necessary.

I have conferred with many orthodontists concerning the possible retarded development of the jaw incident to the early removal of the third molars. They prefer them removed whenever possible before they start their orthodontic work, especially when the teeth are correctly diagnosed as possible impactions. They hate to see their excellent results impaired because of the pressure exerted by the growth of the impacted third molars.

ARGUMENTS IN FAVOR OF EARLY REMOVAL OF IMPACTED MANDIBULAR THIRD MOLARS

1. Prevents periodontal lesion distal to the second molar.
2. Precludes local foci of infection harbored under flaps and around partially erupted third molars.
3. Obviates difficult surgery and postoperative pain incident to the removal of these teeth when fully developed.
4. No broken and retained fragments of roots.
5. Less shifting of inclined planes resulting in traumatic occlusion.
6. Great aid to orthodontist in retaining position of teeth after regulation.
7. Eliminates possibility of reflex pain due to pressure and nerve irritation.
8. Avoids acute inflammation and abscesses necessitating drainage and other treatments.
9. Because often these teeth are poorly developed and very susceptible to caries.

ARGUMENTS AGAINST EARLY REMOVAL OF IMPACTED MANDIBULAR THIRD MOLARS

1. Difficulty in handling young patients.
2. Possible injury to inferior maxillary nerve and artery.
3. Possible arresting, or interfering with, the development of the mandible.

Much depends upon the ability of the operator to use psychology in the management of such young patients.

There is greater danger of injuring the mandibular nerve and artery in adults than in those operated on early in life. This is because the alveolar bone is completely deposited around adult roots; whereas in children there is neither alveolar bone nor roots of teeth. Also the development of the inferior dental canal is quite pronounced in these young patients.

It seems the development of the jaws is decidedly controlled by hormones produced by internal secretory glands liberated in the blood stream, and possibly the lymph system, and carried to developing cells of the body. It is questionable that the presence of the third molar influences the growth of the jaw: first, because a great number of normally developed mouths have no third molars; second, because bone development is definitely proved to be controlled by gland functions as evidenced by the disease known as acromegalia. In this instance there is an overgrowth of the pituitary bodies that causes the bones of the entire body as well as the jaws and face to grow and develop abnormally.

CASE REPORTS

CASE 1.—Girl, age thirteen years, whose father had badly impacted third molars. Older brother devoid of one third molar. Older sister with four impacted third molars. When this child was operated on, only 2.5 mm. of the crown of the third molar was developed. This and the developmental sac were easily removed, and recovery was uneventful.

Fig. 1.—Case 1, before and after treatment.

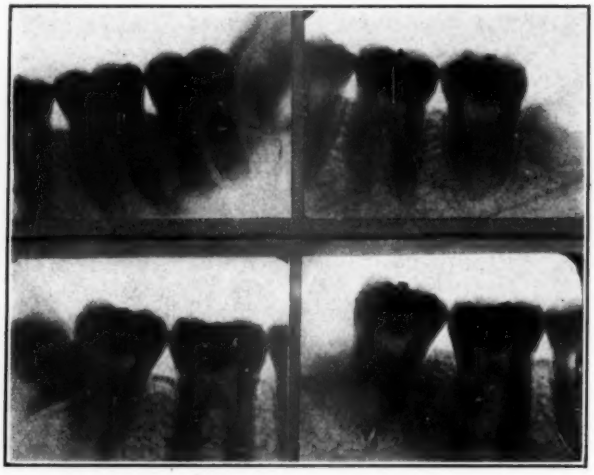

Fig. 2.—Case 2, before and after treatment.

CASE 2.—Boy, age fifteen years. Father had badly impacted third molars. Older sister had two partially impacted mandibular third molars. In this particular case the crown was completely formed. The operative approach of the circumference of the opening was necessarily large to permit crown delivery. There was very little discomfort, and an uneventful recovery followed.

1704 EXCHANGE BLDG.

DIAGNOSTIC IMPORTANCE OF THE TONGUE IN INTERNAL MEDICINE*

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EXAMINE the Tongue! Were the tongue carefully inspected in every patient reporting to the physician or dentist, important diagnostic pointers would frequently be found. Too many clinicians merely order "Stick out your tongue" and ten seconds later have no idea what they have seen. They have looked but have not seen. In the Chinese language, there are two words, one meaning "to look," the other, "to look see"; it is this ability "to look see" which should be developed by physicians.

There are practitioners who unfortunately resort too much to the laboratory method of diagnosis. Examination of the tongue and palpation of the pulse have fallen by the wayside with many young physicians. Gastrointestinal roentgen rays, gastric and duodenal analysis, electrocardiographs, orthodiagrams, and the like are often needlessly requested before a thorough history and physical examination of the patient have been completed. This is true, to a lesser extent perhaps, in our hospital wards and outpatient departments. An overzealous but misguided interne, in a mistaken effort to prove his skill before the chief, will drive a tired, weakened patient through the gamut of special tests in the shortest possible time to have the diagnosis the following morning for ward rounds. He may ignore important leads in diagnosis presented by such simple maneuvers as examination of the scalp and skull for possible metastatic lesions, inspection of the tongue, finger nails, umbilicus, and anus, and palpation of the pulse.

Hippocrates described the tongue as it appears in numerous diseases. Careful routine inspection of this organ reveals manifestations of many systemic diseases. Among these are the chancre, mucous patch, or gumma of syphilis; the strawberry tongue of scarlet fever; the smooth glossy appearance in pernicious anemia and sprue; the pigmentation in Addison's disease; the pallor in severe anemias; the cyanosis in congestive heart failure, congenital heart disease, and polycythemia; the dryness in diabetes mellitus, fevers, mouth breathers, and dehydration; the recurrent canker sores in allergic individuals; the ulcerations of acute leucemia and agranulocytic angina (pernicious leucopenia[3, 7]); the characteristic lesions encountered in drug sensitivity or poisoning; the glossitis of severe anemias of pregnancy, dysentery, simple achlorhydric anemia, and Plummer-Vinson syndrome; the yellow pigmentation most evident along the margins in obstructive jaundice; the tremors of paralysis agitans and hyperthyroidism; the sharp, quick, jerky movements of the tongue in chorea; the scars of epilepsy; these are examples of the importance of the tongue for internal medicine.

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The lymph drainage from the tongue is chiefly to the submaxillary and upper and lower deep cervical nodes; the submaxillary nodes receive drainage from the anterior two-thirds of the tongue; the deep cervical nodes, from the posterior third. The motor nerve supply of the tongue is from the twelfth nerve. Since the nucleus of this nerve lies well below that of the facial nerve (seventh), paralysis of the tongue may occur on the side opposite to that of a concomitant facial palsy. In paralysis of one side of the tongue, this organ when protruded deviates toward the paralyzed side pushed by the nonaffected muscles on the healthy side. Ignorance of this relation has led to faulty neurologic diagnosis.

Common sensation for the anterior two-thirds of the tongue is excited through the lingual branch of the fifth nerve; whereas the glossopharyngeal nerve excites common sensation and taste for the posterior third. The sensation of taste for the anterior third is stimulated through the chorda tympani. In diseases involving the epiglottis, one not infrequently encounters reflex cough or hiccough; this has an anatomic basis, for the epiglottis as well as a small area of the tongue anterior to it is supplied by the internal laryngeal branch of the superior laryngeal nerve.

To evaluate the abnormal tongue, familiarity with the tongue is indispensable, noting particularly color, fur, pallor, papillae, evidence of inflammatory changes, blood vessels on the under surface, form, size, movement and humidity. Most textbooks of medicine today devote little space to this organ. The diseases they describe usually include acute, chronic, and Moeller's glossitis, black tongue, leucoplakia, syphilis, tuberculosis, mycoses, and tumors.[16] The tongue may be narrow and pointed at the tip or large and flabby with a thick and rounded tip and with margins marked by the teeth. In nervous individuals, the tongue is quickly protruded and quickly withdrawn. In the phlegmatic, its motions are sluggish. In old age, the tongue is usually coated and less moist than in younger individuals and becomes dry and even glazed at the onset of the slightest ailment. This is of importance lest we regard as serious that which is only a trivial disorder.[4]

Alterations in the appearance of the tongue are commonly related by the lay mind, as well as by many physicians, to disorders of the gastrointestinal tract. It has been regarded as the mirror of the stomach.[19] Lewis[14] says: "red raw tongue, red raw gut." The time was not far distant when a white tongue was looked upon as a sure sign that the stomach was out of order and that a dose of calomel was indicated.[5] Many persons have a coated tongue in health, especially smokers.[4]

The coated tongue is the abnormality most frequently encountered. The so-called fur of the tongue is thickened epithelium covering the filiform papillae plus various bacteria. The filiform papillae are the most numerous and smallest of the papillae. Each is a conical projection, sometimes ending in fringes of hairlike processes. The epithelium covering these is constantly shed and worn away and as constantly replaced.[8]

Fitzwilliams[8] has divided the process of furring of the tongue into several stages: the dotted or stippled tongue, the coated or loaded tongue, the white

strawberry tongue, the furry or shaggy tongue, and the typhoid, dry, brown, crusted tongue. The dotted tongue often occurs with the slightest gastric upset or dietary indiscretion. The strawberry tongue is characteristic of the early stages of scarlet fever, but is also seen in many acute infections, including acute bronchitis, typhoid fever, pneumonia, etc. A diagnosis of scarlet fever should never be made on the appearance of the tongue alone. A coated tongue is frequently seen in association with emotional disturbances in the patient. In intestinal disturbances not complicated by a deranged stomach or dehydration, there is no characteristic change in the tongue; but habitual constipation is often associated with a large, furred tongue. The tongue may be furry in areas which are temporarily out of use, as around chronic ulcers when pain immobilizes this part. A crusted, brown tongue is frequently encountered in intestinal obstruction, peritonitis, terminal cardiac failure or malignancy, etc.

A red, bare or smooth appearance of the tongue may be associated with long standing chronic disorders, such as empyema, dysentery, diabetes, tuberculosis, etc. The wearing of an upper plate over long periods of time occasionally produces a smooth, polished, bright red tongue, without pain or inconvenience. Although in many acute disorders of the gastrointestinal tract the tongue tends to become furred, in acute gastritis it is frequently red, especially at the tip and edges. In acute peritonitis, the tongue is usually small, red, and tender, with little fur and is usually dry.

In carcinoma of the stomach, the tongue may be clean and appear healthy if there be no associated febrile reaction. Schwindt[20] has found in many cases of gastric or duodenal ulcer a peculiar change in the tongue manifested as multiple, round or oval, confluent epithelial defects, which disappeared on healing of the ulcers. These looked like superficial ulcers, were not sensitive, and were frequently symmetrical; they were approximately 2 to 8 mm. in size; the edges were smooth. He saw them occasionally with carcinoma of the stomach. In most instances, these lesions were chiefly on the posterior part of the tongue, in the middle, anterior to the large papillae; occasionally they were unilateral.

Fenwick[6] noted a definite smell from the tongue itself (not from the breath) with abdominal sepsis. This may be the smell characteristic of pus or rather a fecal odor, sickening to the observer. He has postulated that the tongue may give the first indication of the extremely rapid absorption (in this case of toxic material) from the peritoneum. This smell from the tongue remained even after gargling and washing the mouth. In these cases the tongue usually was not covered by fur, but was dry and beefy.

Discolorations of the tongue may be significant or may be derived from the foodstuffs. Significant changes occur in Addison's disease, xanthelasma and ecchymoses (as from injury, purpura, or scurvy). In Addison's disease, in addition to the pigmentation elsewhere in the body, there are often bluish-black smears on the mucous membrane of the lips, cheeks and tongue, as if a pen had been wiped upon them. Stains from fruits, acids and alkalis, metals, chocolate, tobacco, nuts, prunes, licorice, etc., may discolor the tongue. The bluish discoloration of the tongue produced by grape juice persists for several hours and can be misleading.

Binkowitz[2] described in relation to the tongue an early sign of cardiac decompensation. If the tongue is protruded from the mouth and is held in a pendant position for at least a minute, the normal red color gives way to a blue or cyanotic hue, or in severe cases becomes almost black. If the patient elevates the tongue to the back of the maxillary incisors without exerting pressure, a marked distention of the ranine veins occurs, which Binkowitz believes is an early sign of circulatory failure.

Glossitis with atrophy of the lingual papillae is a common manifestation in pernicious anemia, achlorhydric anemia, the anemia of pregnancy,[13] pellagra, sprue, Plummer-Vinson syndrome,[17, 21-23] malnutrition attended by dysentery and anemia,[11] intestinal stricture, pyloroplasty complicated by peritonitis, dibothriocephalus latus infestation[10] and achlorhydria.[15] Middleton showed that rats placed on a low vitamin B diet present a smooth bald tongue with marked papillary atrophy. He inferred that in most cases an atrophic tongue is dependent on vitamin B deficiency. The completely bald tongue associated with pernicious anemia can exhibit return of papillary markings with liver treatment.

Middleton[19] made tongue prints on smoked paper. His conclusions were as follows: Patients with hyperchlorhydria rarely have smooth tongues, but often scrotal or coated tongues. In organic nonmalignant disease of the gastrointestinal tract there is a tendency to the coated and scrotal types of tongue. This is more marked when hyperchlorhydria coexists and is apparently proportional to the degree of the hyperacidity. Peptic ulcer shows the most evident tendency in this direction, with chronic colitis and chronic cholecystitis following in order. When there is achlorhydria, smoothing of the tongue is common. Functional conditions are rarely attended by smoothing of the tongue. Neither normal nor coated tongues are commonly associated with anemia.

Urticaria may occur locally on the tongue. One such allergic patient could never eat fish without a crop of blisters developing on his tongue.[8] Lindsay[15] describes a patient in whom canker sores came regularly on the tongue within twenty-four to forty-eight hours after eating even the smallest amount of English walnuts. Great swelling of the tongue may develop on an allergic basis; the tongue may also become edematous as a consequence of any inflammatory condition within the mouth, arising either from a general condition as in mercurial stomatitis, or from local disorder as in ulceration of the gum around a tooth with an infected socket.[1]

Among the many causes of "burning tongue" as well as of small ulcerations on this organ is an electrogalvanic burn caused by dentures composed of two metals constituting a galvanic battery, the saliva acting as an electrolyte. Lain[12] has pointed out that such galvanic currents may be set up in the mouth generated by two metals used in dental fillings, crowns, and bridgework.[9]

An uncommon abnormality of the tongue is the occurrence of a lingual thyroid. In this condition for some unknown reason the anlage of the thyroid gland, which arises in the region of the base of the tongue, fails to migrate or migrates incompletely; 144 proved cases of this condition have been recorded.[18] The symptoms are not characteristic, and arise merely from pressure in this region, resulting in dysphagia, dysphonia and dyspnea. The lesions are usually

small, round, hemispherical masses protruding into the pharyngeal fossa. Removal of these masses may produce hypothyroidism. They frequently respond to iodine and thyroid medication.

Other lingual manifestations of systemic disease include uremic stomatitis, disturbances associated with blood dyscrasias, drug eruptions, mycotic infections, neurologic disorders, etc. These will be made the subject of a later report.

SUMMARY

1. A plea is made for adequate inspection of the tongue of all patients.
2. Some common lingual manifestations of systemic diseases are described.

The author wishes to express his appreciation of the assistance rendered by Dr. J. Harold Austin in the preparation of this manuscript.

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NEURALGIC PAINS AND SOME OF THEIR CAUSES

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THE slightest toothache can be a causative factor in referred pain, and with the removal of the offending member the condition is relieved; but there are conditions which are deeper rooted, and often those cases are mistaken and treated for tic douloureux when the causative factor may be impacted teeth, calculi in the duct of a gland or in the gland itself, impactions of supernumerary teeth, etc.

Case 1. Patient, male aged 35 years, had been treated for tic douloureux for three years. Four alcohol injections had been given the patient at intervals

Fig. 1. Fig. 2. Fig. 3.

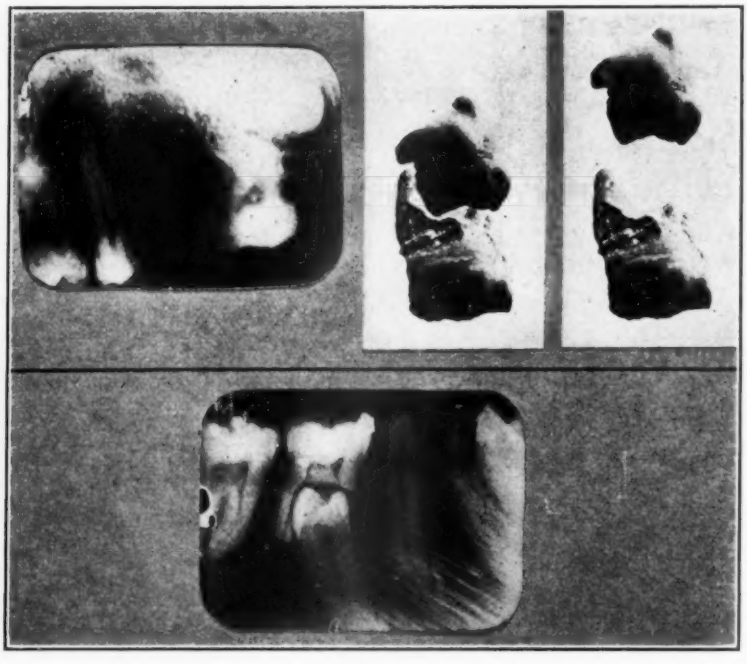

Fig. 4.

ranging from eight months to three months; these had relieved the pain during the intervals of the injections. Radiographic findings (Fig. 1) revealed an impacted third molar; the second molar and all other teeth on the same side were vital. Transillumination showed clear on all teeth.

Figs. 2 and 3 show the findings at operation. The third molar had resorbed two buccal roots of the second molar by pressure, and the root canals were found to be putrescent.

All the tests had failed, for a number of reasons. The vitality of the second molar had been supplied from the vitality of the third molar. Transillumination had failed because there was a fistula into the maxillary antrum from the second molar area (transillumination depends upon congestion). The pain had

originated from the dead second molar and the impaction had no bearing on this case. The patient has been entirely relieved for four years without further treatment.

Case 2. The patient complained of neuralgic pains in the right mandible, with referred pain about the ear and the right side of the frontal region. All

Fig. 5. Fig. 6.

Fig. 7. Fig. 8.

teeth appeared to be normal. An x-ray picture (Fig. 4) revealed an impacted bicuspid, which was not observed on clinical examination until after the teeth were counted. The bicuspid had resorbed the roots of the molar, and the causative factor was the dead pulp of the first molar. Extraction of the molar relieved the condition entirely, and there was no recurrence of the pain in six years.

The bicuspid was allowed to erupt, and took its place in the arch in the space of the molar; contact was restored between the bicuspid and the molar.

Case 3. Patient, male aged 35 years, complained of neuralgic pains caused by an impacted second molar and odontoma (Fig. 5). There was a complete recovery after removal of both. The condition remained clear after five years.

Case 4. Patient, female aged 30 years, had an acute infection of the central incisor, with a fistula which discharged through the nares and the maxillary antrum. There was a neuralgic condition of long standing. The central incisor was removed under a general anesthetic. After the acute stage subsided, the impacted supernumerary and the impacted bicuspid were removed. Note in Fig. 6 that the cuspid was in position.

Infection from the central incisor had infected the follicle of the supernumerary tooth, which in turn infected the follicle of the impacted bicuspid, and the fistula in the nose and the antrum resulted. The condition was entirely relieved, with no recurrence in three years.

Fig. 9.

Case 5. Patient, male aged 42 years, complained of terrific pain in the region of the left maxillary parotid. All teeth were vital, and the patient was wearing expensive restorative appliances. Saliva from the submaxillary and parotid ducts was normal. There was slight sensitiveness just above the parotid duct. Radiographic examination of the teeth was negative, but a radiograph (Fig. 7) of the parotid region revealed calculi in the parotid duct. Fig. 8 shows the probe passed and the calculi lying close to the orifice. On removal of the calculi, the condition cleared up completely. It is interesting to note that the crowned teeth in this case had been condemned and were about to be removed, but the patient is still wearing the appliances with comfort four years after removal of the calculi.

Case 6. Patient, male aged 35 years, complained of neuralgic pains and severe headaches. All teeth were normal, but there was an impacted tooth in

the region of the sigmoid notch (Fig. 9). The value of an operation to remove this impacted tooth was doubtful in view of the amount of damage to be done compared to the possible good which might result.

An injection of alcohol was given (conductive); this anesthetic lasted eight months, and the patient's condition was entirely relieved without further treatment. Rest of the nerve irritation was all that was needed to clear up this case, and there has been no recurrence of the condition in seven years. The impacted tooth is still in position.

Fig. 10.

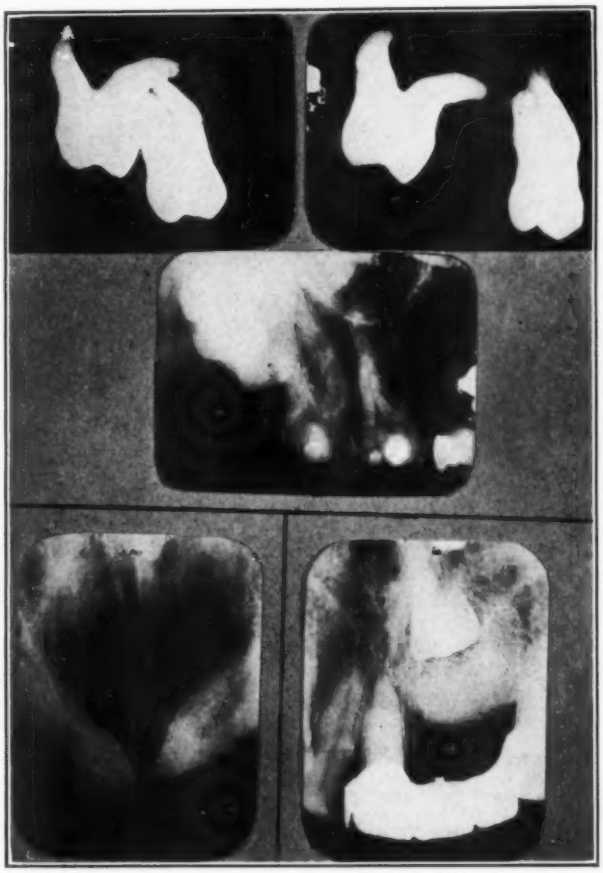

Fig. 11. Fig. 12.

Case 7. Patient, male aged 38 years, complained of neuralgic pains of long standing. Condition was entirely relieved by removal of a third molar and a supernumerary tooth (fourth molar) which was impacted. (Fig. 10.)

Case 8. Patient, female aged 52 years, with edentulous mouth, complained of neuralgic pains of long standing, noticed only when dentures were worn. The x-ray examination (Fig. 11) revealed impacted cuspids. These were removed and the condition cleared up entirely. The case was checked four years later.

Case 9. Patient, female aged 30 years, complained of neuralgic pains in the maxillary central incisor region. A replacement had been made without

the region's being examined by x-ray. A radiograph (Fig. 12) revealed an impacted central incisor and an odontoma. Both were removed, and the case cleared up entirely. Case was checked six years later.

Case 10. Patient, male aged 32 years, a police officer, complained of neuralgic pains in the left side, referred about the left ear. He gave a history of having been shot. The lead had not been removed from the jaw, and it had completely changed the course of an impacted tooth to a posterior inferior position. (Fig. 13.)

External palpation gave the position of the metal close to the surface. The condition was relieved after the metal was removed from the tissues. No attempt was made to remove the impacted molar or all of the metal. There has been no recurrence of the pain in eight years.

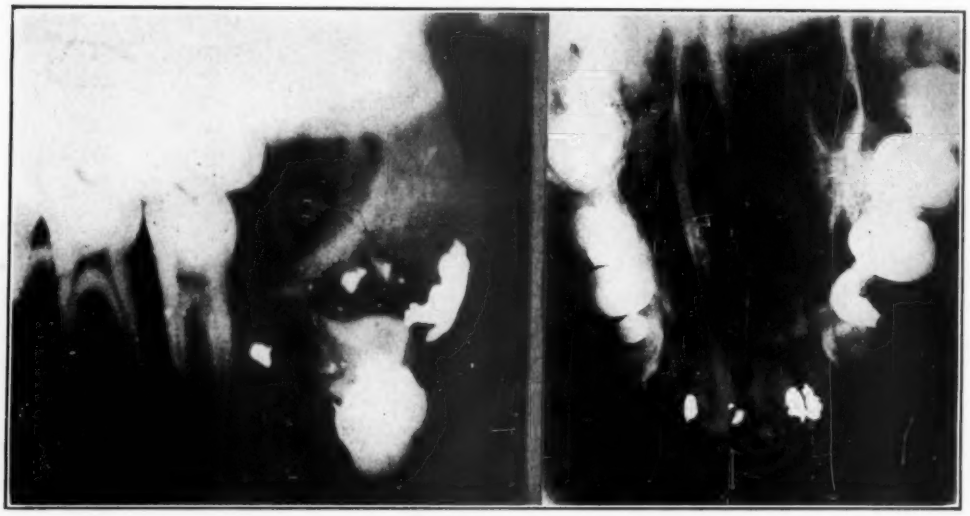

Fig. 13.

Fig. 14.

Case 11. Patient, male aged 34 years, complained of neuralgic pain in the anterior region of the mouth about the central incisors. Removal of both central incisors, which had pulp involvement, did not relieve the condition. After an impacted supernumerary tooth with a dentigerous cyst was removed, there was complete recovery. There has been no recurrence in eleven years.

Each of these cases was handled on its own merits. The age, the physical condition of the patient, previous treatment, and duration of pain are important factors in determining treatment. The value of an operation in each case must be carefully considered. In a number of these cases the most conservative methods brought the desired results; whereas the radical procedure might have ended in disaster.

RELATIONSHIP OF POSTERIOR MANDIBULAR TEETH TO MANDIBULAR ALVEOLAR CANAL

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THE roots of the posterior mandibular teeth present various anomalies. While it does not appear possible to account for all of them, the purpose of this study is to investigate the close relationship between the posterior mandibular teeth and the mandibular alveolar canal. The incidence of these anomalies is of interest, and their etiology is of much importance.

The material presented here is the result of a detailed study of 3,000 cases. In a large number of the cases preoperative roentgenograms were carefully studied and compared with gross specimens upon removal.

Not only were the preoperative roentgenograms and gross specimens studied, but a close inspection was also made of the socket at the time the tooth was removed.

What influence has the relationship of the posterior mandibular teeth and the mandibular canal upon the etiology of anomalies of shape, form and size of adjacent roots and teeth?

Incidence of Anomalies.—In this work extending over a period of seven years, 3,000 clinical cases were examined, and the incidence of anomalies was found to be 4 per cent, or one in every 25 cases.

These findings will no doubt be increased as other workers begin to pay more attention to this phase of dental anatomy.

In a study of this nature we must realize that a great number of cases will have to be studied in order to arrive at anywhere near a correct figure for the occurrence of these anomalies. One might examine several hundreds of cases and still not find one single typical case; on the other hand, a hundred cases might be studied and fifty of them fall into this class.

This work has been called to the attention of a number of men, and they were asked their percentage of findings. It was strange to learn that most of them had not noticed these anomalies, while others considered them extremely rare. The average figure given by those asked was around one in one thousand. It was also interesting to note that after their attention was called to this study, their findings were greatly increased; some even reported figures as high as 10 per cent, although this would appear to be somewhat high.

It is thought that from an average of all types of practice, 5 per cent will more likely be the correct figure reached as this work is carried on.

Preoperative Diagnosis.—In view of the frequent occurrence of anomalies of this type and the dangers encountered in the removal of these teeth, it is important to study them carefully before operation. Clear roentgenograms correctly taken are essential. By carefully observing all the details and by using a magnifying glass, a correct preoperative interpretation may be made. This will suggest many possibilities to the operator. In many cases the roots appear to

be in the mandibular alveolar canal; while the canal is to either the buccal or the lingual of the roots, or there might be a groove or bifurcation of the roots. This is shown in the paper.

The preoperative study is of much importance because it allows the operator the opportunity to inform the patient of the postoperative sequelae which arise in many of these cases. This of course saves the operator much embarrassment when at a later date these sequelae do appear, and it also tends to cause a better understanding between the operator and the patient.

A.

B. *C.*

Fig. 1.—Fractured roots of mandibular third molar; very thin mandible. (Case of E. J.)

A, Radiogram of fractured roots of mandibular third molar. Note the course of the mandibular alveolar canal, how it dips down in the third molar region. The roots appear to extend into the canal. Also note how thin the mandible is in the third molar region.

B, Showing buccal view of roots. The mesial and distal roots are fused at the apical third; the buccal portion of the mesial root curves to the distal while the buccal portion of the distal root curves to the mesial. The lingual portions are straight and extend downward below the level of the buccal portions.

C, Showing mesial view of roots. Note that there is a groove which runs from mesial to distal across the apical surface of the roots. This groove conforms perfectly with the relationship of the roots to the mandibular alveolar canal.

Operative Procedures.—In the removal of impacted mandibular premolars and molars, it is just as essential to have the preoperative roentgenographic

study as in the case of roots, taking into consideration the question of the character of the osseous structure; the relationship of the adjoining teeth; the question of the height of the tooth in the osseous structure; the relationship of the impaction to the adjoining teeth; the position mesiodistally and labiolingually as shown by lingual views, and occlusal intraoral, and extraoral roentgenograms. It is essential that the tooth be studied as to its pulp chamber as to whether the tooth is in torsion.

The type of impaction such as vertical, mesioangular, distoangular, or horizontal should be determined; the character of the root formation should be studied as to whether there is a fusion of roots, straight roots, or roots turned

Fig. 2.—Dentigerous cyst, containing mandibular second molar. (Case of W. A. C.)

A, Radiogram showing dentigerous cyst of mandibular second molar area. Within the cyst is found the mandibular second molar. The crown is covered with cholesterine forming a cholesteatoma. The roots rest on the lower border of the mandible, and they curve slightly to the distal. The canal appears to stop at the mesial root of the mandibular third molar.

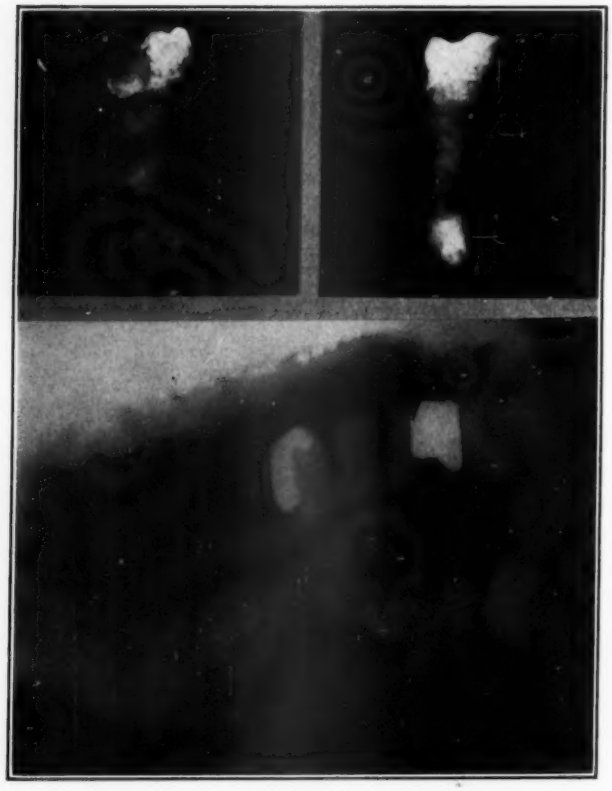
B, Showing mesial view of tooth. The roots are fused, forming one solid root. There is a very deep groove which runs from mesial to distal through the root. This groove conforms perfectly with the relationship of the root to the mandibular alveolar canal.

C, Showing distal view of tooth. Note how much deeper the groove is on the mesial than on the distal. Also notice that the buccal and lingual portions of the root nearly fuse at the apex on the distal.

This tooth had to be carefully removed in order to free the contents of the canal, as they were caught in the groove at the distal.

distally or mesially, or both roots turned toward each other, or whether they are turned buccally, or lingually, or whether there are extra roots; whether the tooth shows an anomaly as outlined in this paper, such as grooves upon the side

A. *B.*



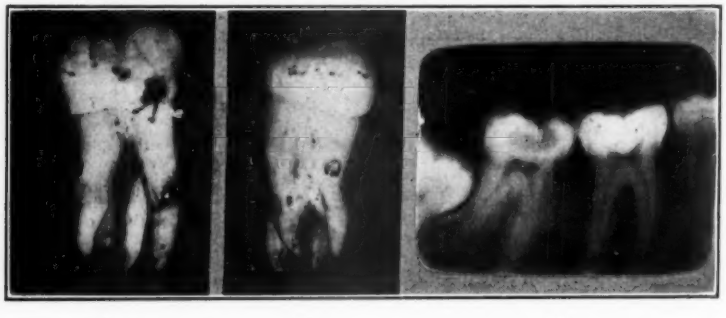
C.

Fig. 3.—Vertical type of impacted mandibular second bicuspid. (Case of R. S.)

***A*, Showing lingual surface of tooth. The tooth was so rotated that its mesial surface was completely on the lingual. The root was long and tapering showing a slight amount of hypercementosis about the apex. There is found a very deep groove on the mesial surface which runs from mesial to distal. This is located at about the mid-section of the root. This groove conforms perfectly with the relationship of the root to the mandibular alveolar canal.**

***B*, Showing buccal view of tooth. Note the groove on the mesial surface; also note how it runs over slightly on the buccal.**

***C*, Radiogram showing vertical type of impacted mandibular second bicuspid. The tooth is very deep and the mandible is thin, the apex of the tooth extends through the lower border of the mandible. It appears that the mandibular alveolar canal runs through the center of the tooth. The tooth appears to be rotated.**



A. *B.* *C.*

Fig. 4.—Second molar with extremely long roots. (Case of H. N.)

***A*, Showing buccal view of tooth. Both the mesial and the distal roots bifurcate and form two roots. The distal root is bifurcated its whole length, while the mesial root is bifurcated only at the apical third.**

***B*, Showing view of mesial root. Note that the apical third bifurcates to form a definite groove. This groove is smooth and conforms to the relationship of the root with the mandibular alveolar canal.**

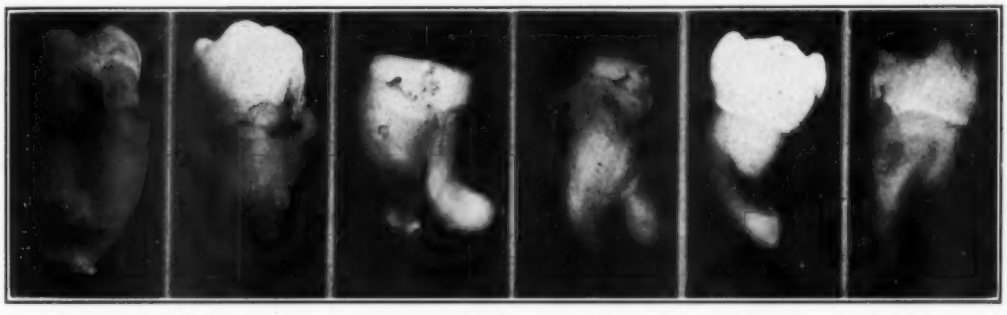
***C*, Radiogram showing second molar with extremely long roots. The roots appear to extend into the canal.**

of the roots, or bifurcated apices, or malformation of the root in the form of hypertrophy or cementoma, or complete malformation of the entire tooth structure, such as fusion with adjoining teeth or supernumerary teeth.

In the removal of roots that border or are in the mandibular canal, it is primarily essential that a definite preoperative study be made so that the proper procedure for their removal may be outlined and followed. It is absolutely necessary that a flap be turned in the operative procedure so that the entire field can be visualized in order that removal of the root may be greatly facilitated.

It is necessary to use a small, delicate, pointed or flat instrument, using a pulling movement rather than a pushing movement to prevent pushing farther into the canal, and to prevent injury especially to the inferior dental nerve. After the nerve is traumatized, regeneration does not take place quickly, and it is to be feared more than cutting the nerve.

Postoperative Sequelae.—Paresthesia of the lower lip and chin is not an infrequent occurrence. Attention is more often directed to it during postoperative treatment following the removal of a tooth. In the patient's mind there is always the thought that the operator has negligently injured some nerve. The fact should not be overlooked, however, that this condition does occur prior to sur-



A. *B.* *C.* *D.* *E.* *F.*

Fig. 5.—*A*, Showing buccal view of tooth. Vertical type of impacted mandibular third molar. The roots are all fused, and greatly hypercementosed. At the apical third running from mesial to distal there is a very deep, smooth groove. This groove conforms perfectly with the relationship of the root to the mandibular alveolar canal.

B, Showing distal view of root of *A*. Note the depth of the groove and how smooth it appears to be when compared with the rest of the root formation of that area. Note that the lingual portion of the root extends downward and forms a sort of a knob.

C, Showing buccal view of tooth. Vertical type of impacted mandibular third molar. The mesial root has two portions; the buccal portion folds over curving to the distolingual and fusing with the lingual portion of the mesial root. The distal root curves to the distolingual, and its apical third forms a knob. Across the apical surface of this tooth runs a very deep groove; it runs from mesial to distal across the buccal surface of the mesial root and the lingual surface of the distal root. This groove conforms perfectly with the relationship of the roots to the mandibular alveolar canal.

D, Showing mesiobuccal view of *C*. Note the very deep groove which is formed by this root formation.

E, Showing lingual view of tooth. Horizontal type of impacted mandibular third molar. There is one solid root which curves upward. The distolingual portion is shortened, forming a smooth groove which runs from below upward and to the distal. This groove conforms perfectly with the relationship of the root to the mandibular alveolar canal.

F, Showing distal view of the tooth in *E*. Note the smooth groove formed by the distolingual portion of the root.

gery in some cases, and there are a number of etiologic factors to be considered. It may be a result of operative trauma, of local infection, or of anemia and diet deficiences.

Roots may fracture during removal of teeth and may be pushed into the mandibular alveolar canal, or there may be injury to the canal or its contents by instrumentation of movement of roots during removal.

A.

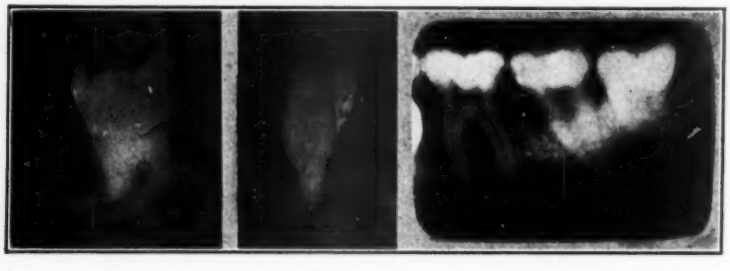
B. *C.*

Fig. 6.—Vertical type of impacted mandibular third molar. (Case of C. T.)

A, Extraoral radiogram showing vertical type of impacted mandibular third molar. It appears that the roots run right through the canal and extend some distance beyond.

B, Showing mesiolingual view of tooth. The mesial root is fused with the distal root on the buccal surface to form one solid root. The distal root is bifurcated, and the buccal portion forms with the buccal portion of the mesial root to form what appears to be one wide buccal root. The lingual portion is fused with a very short lingual portion of the mesial root. By this formation there is formed a very deep groove which runs from mesial to distal across the apical surface. This groove conforms perfectly with the relationship of the roots to the mandibular alveolar canal.

C, Showing mesial view of tooth. Note the very deep groove and also notice that the lingual portion of the mesial root is cut into by the groove.



A. *B.* *C.*

Fig. 7.—Vertical type of impacted mandibular third molar. (Case of D. H., left side.)

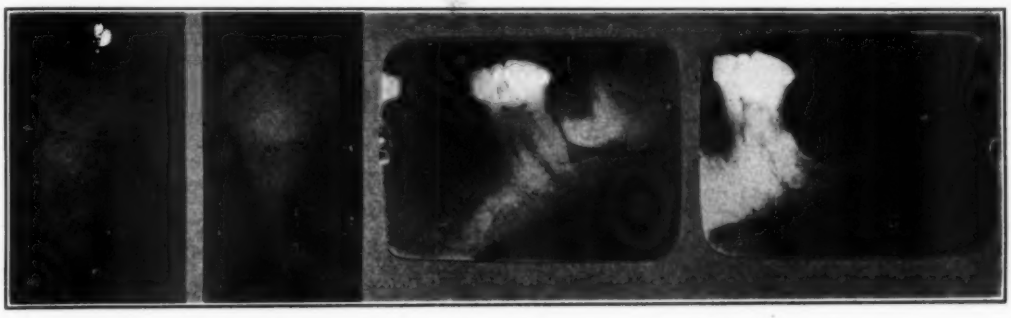
A, Showing buccal view of tooth. The mesial and distal roots are fused together to form one very long thin root which curves at almost right angles to the distal. The two roots can be clearly outlined. The buccal portion of the mesial root curves over on the buccal surface of the distal root.

B, Showing apical view of roots. The folding of the mesial root can be clearly seen from this view. There is a shallow groove which runs from mesial to distal across the apical surface. This groove conforms perfectly with the relationship of the roots to the inferior alveolar canal.

C, Radiogram showing vertical type of impacted mandibular third molar. At about the middle of the root it will be noticed that both the mesial and the distal roots curve at a sharp angle to the distal. This distal half of the root seems to approximate the superior wall of the canal.

Anatomic Variations.—During the formative period of the tooth, the crown is formed first, the roots being the last part of the tooth to calcify. When they reach the mandibular alveolar canal, they are in a plastic state, and the constant pulsation of the vessels within the canal tends to mold them into various anomalies.

This process is easily explained when we stop to study the formation of the many foramina of the bones of the body, especially those of the skull. The vessels are formed first, and the osseous structures are laid down around these pulsating vessels; the osseous structure at first is plastic and is kept in constant motion until calcification is completed. Thus a foramen is formed.



A. *B.* *C.* *D.*

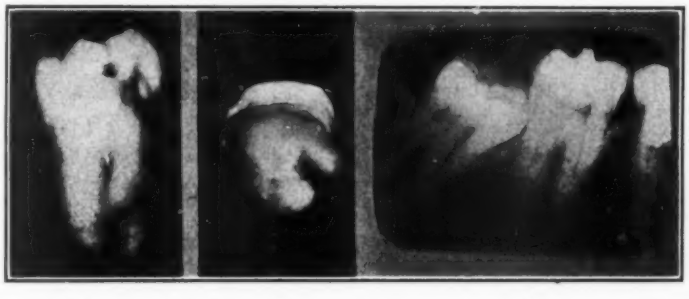
Fig. 8.—Mesio-angular type of impacted mandibular third molar. (Case of W. W.)

A, Showing buccal view of tooth. There is one solid root and the mesial and distal roots cannot be defined. Across the apical third of the buccal surface there is found a deep smooth groove which runs from mesial to distal. This groove conforms perfectly with the relationship of the root to the mandibular alveolar canal.

B, Showing distal view of tooth. Note the depth of the groove. The apex shows a slight curvature to the buccal.

C, Radiogram showing mesio-angular type of impacted mandibular third molar. The root has not all been shown in this radiogram but it appears that the root would extend into the canal.

D, Postoperative radiogram taken at time of removal. Note that it appears that root extends to the lower border of the canal. Also note the amount of bone removed.



A. *B.* *C.*

Fig. 9.—Mesio-angular type of impacted mandibular third molar. (Case of B. S.)

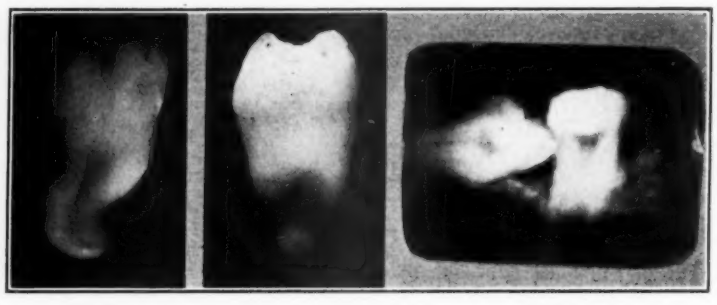
A, Showing buccal view of tooth. The mesial and distal roots are fused down to about the apical third. The mesial root bifurcates at the apical third; the buccal portion curves to the distal and is fused to the distal root; while the lingual portion extends downward to the lowest level of the tooth. There is a groove which runs across the lingual portion of the mesial root and also across the buccal surface of the distal root; this groove runs from mesial to distal and conforms perfectly with the relationship of the roots to the mandibular alveolar canal.

B, Showing apical view of roots. Note that the buccal portion of the mesial root is shortened and shows groove. Note also that groove extends across buccal surface of the distal root.

C, Radiogram showing mesio-angular type of impacted mandibular third molar. The roots appear to extend through the canal and pass about 3 mm. beyond the inferior wall of the canal.

In order to see just what changes pulsating vessels will cause in even calcified structures, we have only to consider a case of aneurysm where the increased pulsations even break down vertebrae and ribs.

There are many cases of posterior mandibular teeth that show bifurcations, grooves, and various other anomalies; yet roentgenograms of these fail to show any relationship of the tooth with the mandibular alveolar canal. Some of these can be accounted for by retarded eruption. If the tooth erupts normally as development is taking place, it will be thrown out of the path of the canal; however, if for some reason this eruption does not take place, then the roots may come in contact with the canal. At this time the anomalies will form; then, if at a later date the tooth erupts, it will still carry with it the anomalies it received during the developmental stage.



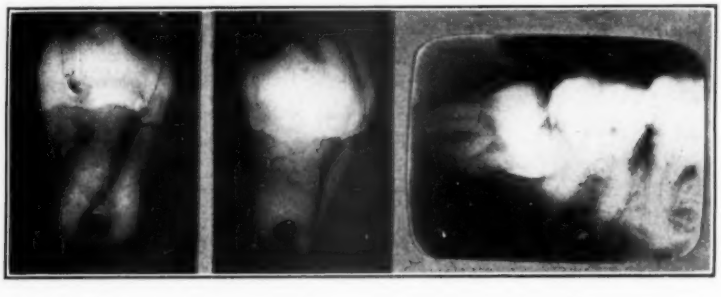
A. *B.* *C.*

Fig. 10.—Mesio-angular type of impacted mandibular third molar. (Case of E. P.)

A, Showing buccal view of tooth. Both the mesial and the distal roots are fused to form one long root. At about the middle of the mesial it curves to the distal, then it curves back again sharply to the mesial. The distal root curves first to the distal and then turns back again curving to the mesial. There is a shallow groove across the buccal surface of the distal root at the position where the second curve is found.

B, Showing mesial view of tooth. It will be noted that there is a very deep groove running from mesial to distal across the apical third of the mesial root; this gives the root the appearance of being bifurcated. These grooves on the roots conform perfectly with the relationship of the roots to the mandibular alveolar canal.

C, Radiogram showing mesio-angular type of impacted mandibular third molar. It will be noted that the mesial root appears to be shortened and approximates the superior wall of the canal; that portion of the distal root which shows appears to extend into the canal.



A. *B.* *C.*

Fig. 11.—Horizontal type of impacted mandibular third molar. (Case of E. R.)

A, Showing distobuccal view of tooth. The mesial and distal roots are separated. The mesial root is bifurcated and curves slightly to the distal. The distal root is somewhat flattened and twisted; across its mesiobuccal surface there is a deep groove.

B, Showing mesial view of tooth. Note the very deep groove in the apical surface of the mesial root; also note the groove on the buccal surface of the distal root. These grooves are well defined and conform perfectly with the relationship of the roots to the mandibular alveolar canal.

C, Radiogram showing horizontal type of impacted mandibular third molar. The mesial root appears to extend into and run along the canal. The distal root also appears to extend into the canal.

To my knowledge teeth do not change their shape after calcification is completed. I have uncovered many imprisoned teeth showing various root formations, but none of these have been altered during their course of eruption.

SUMMARY

The roots of the mandibular teeth, especially those which are impacted or in cases where the roots of the teeth are exceedingly long, present various degrees of curvature, and marked anomalies. These anomalies and curvatures are not all due to just freak developmental factors.

Nature has her way of protecting vital structures by changing the course of less vital structures in order to avoid encroachment. It seems that this has been fulfilled in the case of teeth which might well have caused damage by pressure upon the contents of the mandibular alveolar canal, as these posterior mandibular teeth show various forms of root formation, which if studied closely will reveal that they have developed in such a manner in order to avoid injury to the mandibular alveolar canal. In many of these cases the roots curve to such a degree as to miss the canal completely, one root being to the lingual and one to the buccal. On others, the roots curve to the distal and bend back upon themselves, etc. Bifurcation of the root end in many of these cases enables the root to escape pressure upon the canal.

The most important finding is the groove which is found to be present in a large percentage of these cases. This groove is accompanied by various root anomalies; such as, curvature, hypercementosis, bowing of the roots, fusion, etc. In cases of very deep impacted or misplaced teeth, this groove may appear upon the side of the root. The mandibular third molar is the best tooth for its study because it is more often impacted and also it is in closer relationship to the canal during the developmental period.

The impacted mandibular third molar of the deep vertical type is the tooth where these anomalies are most frequently found; however grooves may be found in and of the roots which come in contact with the mandibular alveolar canal.

It appears that these grooves are formed around the canal. The steady pulsating of the inferior alveolar artery has much to do with their development. It is thought by some men that they are formed by coming in contact with the walls of the canal, which are composed of bone of slightly more density than the spongy bone of the center of the mandible. We must discount this to a certain extent when we think of roots which develop in very deep impactions and extend through the cortical bone of the inferior border of the mandible. They do not curve and are not flattened out when they reach this dense bone. In cases of impacted maxillary cuspids, the roots are usually normal except where they curve or where there is hypercementosis produced to avoid encroachment upon the sinus, nearby teeth or nerves. This rule holds true in a large number of cases. Often, however, we cannot account for certain anomalies of the roots of the posterior mandibular teeth.

CONCLUSIONS

After viewing over 3,000 cases, I have found that anomalies of the mandibular premolars and molars occur in 4 per cent of the cases, or one in every twenty-five. Anomalies which are caused by other conditions than the environment of the mandibular canal are very infrequent.

These anomalies of the mandibular teeth occur, therefore, not infrequently, and not so rarely as one would suspect from reviewing what little literature there is upon this subject.

The curvature of the roots, grooves, bifurcations of apices, etc., appears to be governed by the vessels in the mandibular alveolar canal, the pulsation of the blood through these vessels, no doubt, accounting for these changed conditions.

The importance of the careful study of these conditions preoperatively and a recognition of all of their significance are conclusive when viewed from the operative standpoint in that it becomes imperative that the operator recognize these conditions in order to prevent postoperative sequelae of a very unfavorable nature as outlined in this paper.

LITERATURE

The literature upon this subject is very meagre. Very little study apparently has been given to it, and only the following references have been found.

"The roots of impacted and misplaced teeth are often built into abnormal shapes during their development in order to avoid encroachment upon important structures, such as the maxillary sinus, the inferior dental nerve, etc." Blair, V. P., and Ivy, R. H.: Essentials of Oral Surgery, St. Louis, 1925, The C. V. Mosby Co.

"When the teeth are normally erupted, the third molar is the only tooth, which, in a limited number of cases closely approximates the mandibular canal. Instances have been reported in which the inferior dental nerve passed through the bifurcation or a perforation of the roots of an apparently normal lower third molar. These anomalies are rare. Although at times scant, there is always some bone separating the canal from the root ends. With caution, therefore, these teeth can be removed without breaking through the bony boundaries of the mandibular canal." Berger, A.: Principles and Technique of the Removal of Teeth. Brooklyn, N. Y., 1929, Dental Items of Interest Publishing Co.

401 Exchange Bldg.

Case Reports

With this issue of the JOURNAL a department of case reports will be started. The cases to be presented should be of interest to all oral surgeons. Discussion of the cases is invited by the Editors. Any comments should refer to the case by number and should be addressed to Dr. Kurt H. Thoma, 47 Bay State Road, Boston, Mass. Readers are also invited to contribute unusual cases of their own for presentation.

CASE REPORT NO. 1

PERICORONAL INFECTION LEADING TO CAVERNOUS SINUS THROMBOSIS

WILLIAM H. HYDE, D.D.S., BROOKLYN, N. Y.

Complaint.—The patient, a male, age 25 years, born in the United States, occupation clerk, white race, presented with pain, swelling and redness of left mandible, of two weeks' duration.

History of Present Illness.—About two weeks before, the patient had noticed that the gum on the left side was painful. He went to the dentist with complaint of toothache in the last two mandibular left molars, which were not extracted because of the swelling. A diagnosis of a pericoronal infection of the third molar was made, and the treatment consisted of hot salt water irrigation inside and cold application on the outside of the face, and painting the mucous membrane with Churchill's iodine. The next day the cheek began to swell and became very painful. He was hospitalized and was treated for eleven days as above with no relief. He then went to another hospital where he came under my care.

Past Illness.—Chickenpox, measles, frequent toothaches.

Examination.—Mouth opened with great difficulty. There was redness and a large swelling on the inner side of the left cheek. The cheek was painful to pressure, and the swelling ran down to about 3 inches below the border of the mandible on the left side of the neck. Teeth showed evidence of neglect. The last two molars on the left side were badly decayed. Neck was swollen and tender on the left side.

Diagnosis.—Osteomyelitis, confirmed by subsequent x-ray examination.

Treatment.—On December 15, 1937, under ether anesthesia, an external incision over the angle of the left mandible was made. A large amount of thick yellow pus was evacuated, and an iodoform dressing was inserted. The temperature dropped from 103.4° F. to 101° F. and the pulse from 110 to 90. A culture of the pus revealed *Staphylococcus albus.*

Subsequent History and Treatment.—On December 16, 1937, staphylo-lysate was applied locally and daily thereafter. On the next day the temperature rose to 104.8° F., pulse to 116 per min. On December 20 prontosil was administered and was continued daily thereafter. The white cell count rose to 29,000. The

lips, cheeks and eyelids were distorted by severe inflammation and a tentative diagnosis of cavernous sinus thrombosis was made (Fig. 1). An ophthalmologist reported eyegrounds negative. A medical consultation was ordered, and a diagnosis of septicemia was made by the physician.

On December 23 a transfusion of 200 c.c. of whole blood was given. Two days later another transfusion of the same amount was given. The temperature dropped from 105° to 96.6° F. on December 24 at 6 A.M. The pulse dropped from 140 to 100. That evening, however, the temperature rose again to 104° F. and the pulse to 140. On December 24 a blood culture showed *Staphylococcus albus;* 500 c.c. of 20 per cent glucose saline was given intravenously. On December 25 the temperature rose to 106.2° F., the pulse to 145. Bacteriophage prepared by Dr. MacNeal of the Post-Graduate Hospital was given. The patient died twelve days after admission with a temperature of 108° F., pulse 150.

Fig. 1.

X-ray Examination.—On December 12 there was no evidence of actual bone destruction in the left mandible, but some roughening of the alveolar margin of the mandible. There was a suspicion of very early osteitis and also of a retained root in the region of the first molar. On December 20, x-ray examination revealed osteomyelitis of the left mandible.

Postmortem Examination.—It was found that besides the cavernous sinuses, all the other venous sinuses were filled with pus. The heart was normal; the lung revealed neither pyemic abscess nor emboli. The opinion was that the infection passed from the jaw to the deep facial vein to the pterygoid plexus and thence to the cavernous sinus. The superficial facial veins and the angular vein showed no infectious process.

DISCUSSION

Dr. Hyde.—From the dental point of view it is rather interesting to find a cavernous sinus thrombosis result from an infection of a mandibular third molar. In reviewing the literature I find that seldom has an infection in a mandibular third molar region produced a cavernous sinus thrombosis.

Dr. Thoma.—This patient received during eleven days so-called palliative treatment. The question therefore arises whether an early removal of the third molar would have prevented the complication. I, personally, favor the establishment of drainage as soon as possible, either by incision or by removal of the tooth. I favor removal of the tooth, especially if it can be accomplished without much operative trauma, because removal of an infected tooth both eliminates the cause and establishes efficient drainage, preventing in most cases cervical lymphadenitis, cellulitis, and phlegmons in the neck, particularly if proper treatment is employed to prevent their occurrence. Hospitalization is of great value in such cases.

Dr. Richard H. Norton, D.D.S., D.M.D., Professor of Oral Surgery, Tuft's Dental School, Boston.—This case report should stimulate considerable serious thought in the dental profession.

We may assume that the general physical history was incidental to this case. The swelling and the pain were indicative of an acute inflammatory process instituted by infection. This infection was, without doubt, an accumulative one, as the pericoronal flap must have been evident for some time. This condition in itself should have been reason enough for removing the tooth and healing by second intention before the acute attack occurred.

The practitioner consulted at the time of the onset of the acute swelling and pain failed in his diagnosis. The facts pointed to the urgent need of establishing radical and persistent drainage, and this could have been accomplished only by the removal of the tooth or the teeth in question, and surgical intraoral drainage carried out.

Churchill's iodine as a counterirritant could have been a powerful irritant and could have in turn lowered the tissue's resistance. The judicious repetition of dilute tincture of iodine would have been far more efficacious.

Apparently Dr. Hyde was called in consultation after the patient had become moribund. Osteomyelitis had set in, and it is quite reasonable to believe that the infection had extended into the glands of the neck. A thrombus was formed in the jugular vein, and a retrograde infection was carried to the petrosal vein or veins and from there directly to the cavernous sinus.

The efficacy of staphylo-lysate has never been determined even under the most ideal conditions; therefore the value derived from its use is questionable.

The use of prontosil daily is also questionable. This medicament has a direct affinity to streptococcus, but no apparent favorable reaction has been noted when used for staphylococcus infections.

My conclusions of this case are: first, that the diagnosis and treatment were not correct when the patient was first seen; second, that the original practitioner did not call for a consultation in the early stages of the case; third, that dentists must learn the fundamental concept of surgery, namely, early and radical drainage.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. EGON NEUSTADT, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. Egon Neustadt, 133 East Fifty-Eighth Street, New York City.

Textbook on Orthodontics (Lehrgang der Gebissregelung). First four volumes. By A. Martin Schwarz, 1937, Urban and Schwarzenberg, Berlin and Vienna.

EXAMINATION OF THE JAWS

Orthodontic diagnosis consists, according to Schwarz, of three separate parts: (1) diagnosis of the occlusion itself, of individual tooth malpositions, and of the relationship of the jaws to each other; (2) cephalometric diagnosis, which considers the relationship of the jaws to the head as a whole; (3) biogenetic diagnosis, which is concerned with the etiology of malocclusion, its course, and its influence upon the body as a whole.

The examination of the jaws is made by means of the following tests: examination of each jaw (missing or supernumerary teeth, contact points, tooth inclination, form of the arch); both jaws in occlusion (occlusal contact, overbite, compensating curve). These tests are conducted by means of inspection and palpation, Roentgen films and casts.

For the proper evaluation of the casts, Schwarz suggests a measuring device which, to a certain extent, is similar to Grunberg's symmetrograph. It consists chiefly of a sheet of cellophane which has millimeter squares printed on it. This sheet is placed over the cast, and the necessary measurements are taken and compared with the mean measurements of normal arches (Pont and Korkhaus). In other instances, Hawley's charts are superimposed upon the cast under examination and used for guidance toward the new arch form. An important matter is the correct location of the median line of the palate, which is found by connecting the centerpoint between the second palatine fold with the last visible portion of the raphe near the soft palate.*

Comparison of both halves of the jaws (as soon as the median line has been located) is easily accomplished by means of the measuring device; it plays an important part in arriving at the correct diagnosis. In the mandible the median line is indicated by the mental spine (Roentgen film) in front, and by a superimposition of the median raphe of the maxilla in back. The insertion of the frenum of lips or tongue is unreliable as a means of locating the center because it varies with varying tooth positions.

*A. Martin Schwarz: True Center of the Jaws. INT. J. ORTHO. 23: 102, 1937.

As far as anteroposterior malpositions are concerned, it is assumed that the molars drift only mesially, never distally. If the corresponding molars are not placed at the same transverse line, the molar which is found to be farther distal is assumed to be in correct position.

Variations in a vertical plane, namely, supra- and intraversion of teeth, are determined by means of the Roentgen film taken from a longer distance. It is also essential to examine the inclination of the teeth in regard to the body of maxilla and mandible. Finally, after all individual malpositions in one arch have been noted, the relationship of the arches to each other is considered.

DIAGNOSTIC FINDINGS

By means of the examination method described in the first part, malpositions, malocclusions and malrelations of the arches are classified according to the following divisions:

1. Irregular number of teeth.
    - A. Supernumerary teeth.
    - B. Missing teeth.
    - C. Persistence of deciduous teeth.
2. Malpositions.
    - A. Malpositions of individual teeth.
        - a. Type of malposition (rotation, tipping, bodily displacement).
        - b. Direction of displacement (labial lingual, mesial distal, supra-infraposition).
        - c. Extent of malposition (coronal, apical, dentoalveolar, total or gnathic).
    - B. Malpositions of groups of teeth.
        - a. Protrusion.
        - b. Retrusion.
        - c. Mesiodistal constriction.
        - d. Transversal compression.
        - e. Open-bite.
        - f. Closed bite.
        - g. Cross-bite.
    - C. Malrelations of the jaws.
        - a. Distoclusion.
        - b. Mesioclusion.
        - c. Malrelations in neutroclusion.
3. Cephalometric diagnosis.

The purpose of cephalometric diagnosis is to demonstrate the relationship between the teeth and jaws, on one hand, and the head, on the other. It should be coordinated with the findings of the tooth and jaw malpositions and not placed above them in value. In instances of jaw displacements, the cephalometric diagnosis aids in determining in which direction the movement is to take place.

Before using the two main aids in cephalometric diagnosis, the photograph and the teleroentgenogram, it is necessary to make a careful inspection of the patient in order to determine: general body build, signs of rickets, asymmetries of face or skull, center of mouth and jaws, breadth of the face, palpation of the jaws. Simon's method is suggested for making gnathostatic photographs, with a slight modification which allows the taking of front and profile views on one film. For this purpose Dr. Schwarz places two mirrors at approximately right angles behind the patient's head. (Fig. 1.)

The teleroentgenogram is taken from a distance of about 3 meters (10 feet), after identifying marks have been placed on eye and ear points in order to locate these on the film.

CEPHALOMETRIC FINDINGS

Simon's gnathostatic method is the first which furnished a means of relating the jaws to face and skull. While it is still in wide use, Dr. Schwarz believes that the teleroentgenogram is far superior at the present time. Both

Fig. 1.

methods are called upon to answer: How does the raphe-median plane of the maxilla lie in relation to the sagittal plane of the head? What is the relationship of the occlusal plane to the eye-ear plane?

The teleroentgenogram permits differentiation between dental, alveolar or jaw displacements. A Class II malocclusion, for instance, may show the whole mandible in distal position, or only the mandibular teeth (either bodily or tipped).

The facial expression in normal and abnormal conditions is considered in great detail. There are four main types of profile changes with which the orthodontist is confronted: (1) mandible distal, lower lip distal, chin distal; (2) mandible mesial, lower lip mesial, chin mesial; (3) maxilla distal, upper lip distal; (4) maxilla mesial, upper lip mesial. The correct evaluation of these malformations is often difficult because even a beautiful face shows occasionally a pattern in which both jaws are decidedly forward, and sometimes they are backward to the "average" face. Therefore the chief consideration in the correction of all malformations is to produce a profile line which is more or less parallel to the average face line, regardless of whether it is mesial or

distal to it, because irregularities of this line (for instance, a step from upper to lower lip) interfere more with a pleasing expression than the mere forward or backward position of the whole jaw area. Under certain conditions, Dr. Schwarz recommends extractions in order to accomplish the desired results.

The author's careful differentiation between "examination" and "findings" is laudable from a scientific point of view, but it makes the reading of the volumes somewhat cumbersome and necessitates repetition. The presentation of the subject matter is clear and, in the main, along conservative lines. The best parts deal with topics which Schwarz has previously made the subject of special study and separate publications; it seems sometimes that other equally important topics are neglected and that the uniformity of the textbooks suffers thereby. The most interesting and valuable chapter is the one discussing facial deformities; these are treated in an original and very logical manner, although the reviewer cannot agree with the necessity for premolar extractions. It is difficult to evaluate the volumes published so far; two future volumes will deal with problems of treatment, which, after all, is the best criterion of successful orthodontics.

The book is abundantly illustrated, and the illustrations are well reproduced. The author has shown great skill in making a number of diagrammatic sketches which drive their point home effectively. The print is of a good size, and the discriminate use of prominent type makes noteworthy statements stand out clearly.

E. N.

Editorials

Orthodontic Training

EVEN though the general practice of dentistry is quite old compared with some of its highly specialized branches, it is to be recalled that if a child grew to adolescence with the maxillary teeth protruding and the chin receding or with what children derisively call "buck teeth" and was driven to distraction with self-consciousness, nothing could be done about it before the era of Angle, Baker, Case, and Kingsley. That time dates back only about forty years ago. Nowadays, however, many things can be done (and are being done constantly) to correct these conditions, by men who are highly trained in their occupations. It must be admitted, however, that even today the majority of such dental deformity in children is not remedied on account of economic factors and because there are not enough men sufficiently well trained in this work to attend all the children in need of treatment.

If a lay writer familiar with the interesting history of orthodontic evolution and its background should attempt to write about the subject in the characteristic vein that such writers usually essay when picturing the history of the practice of dentistry, he might start out by saying that about forty or forty-five years ago the practice of orthodontics, or the art of straightening the teeth, was nothing more than an ambitious experiment and that the approach to the subject at that early period was entirely mechanical. Then he might follow the various stages of orthodontic metamorphosis and bring the story up to 1938; in dealing with the period he might well say that orthodontics now has a conspicuous and important rôle in health service for children and that there are many highly trained workers who devote their entire time to this field of child health.

This leads up to the present time, when orthodontics is attracting more attention than at any other period of its evolution. Accordingly, in recent years its workers have been called upon "to turn the other cheek," as it were, to epithets hurled from sundry sources. Articles in dental journals have charged orthodontists with being intolerant and indifferent toward public welfare; orthodontists have been accused of failing to encourage the general practitioner to include orthodontics in his regular practice.

If we take the pains, with an open mind, to double back a short distance on the orthodontic trail, in search of a reason for these accusations, accepting first the premise that where there is an "effect" there must be a "cause," we shall find one of the most interesting and spectacular accounts ever written in the history of the science and art of dentistry—and the trail is fresh, the path having been beaten in the time of only one generation.

First we find that the late Dr. Edward H. Angle actually started modern orthodontic teaching when he organized his private school years ago when he

observed that dental schools of that day were not teaching the subject of orthodontics to dental students in a comprehensive and thorough manner. He indicated that those in authority in outlining dental curriculums at that time were indifferent to the subject because it was difficult to teach and because it was somewhat experimental in character. It was said that the subject did not blend well with others in dental teaching, and that its baffling clinical aspects in particular were full of grief for students and also the faculty. By this gesture, Angle started the serious teaching of orthodontics. He created the spark that started the ball rolling; and, even though most of his teaching was done privately, Angle was one of the most inspiring teachers that dentistry has ever known; he had the extraordinary gift of injecting into his subject something that at once kindled both the emotion and the imagination of his students. Even those who took issue with him and with his methods were unanimous in the opinion that he was an outstanding teacher whose subject came first in his life and to which everything else was secondary. He had that rare talent of the *real* teacher which enabled him to project a burst of enthusiasm and *drive* into his students for their work and its advancement that was nothing short of uncanny. He had color as an individual and left his mark on this specialty that will never be erased and probably will never be duplicated in the yet unwritten history of dental teaching.

Although revered in many quarters and at the same time severely criticized in others, it is everywhere admitted that Angle created an atmosphere of zealousness about the subject of orthodontics from a teaching standpoint, that was scarcely known in dental teaching up to that time. It is interesting to review the literature on orthodontic education of the past ten years—from article to article, from editorial to editorial, from author to author, from committee report to committee report. In so doing, it becomes difficult to reconcile oneself to the opinion that orthodontic education has even now changed so much in its status quo from the time Angle made his observation at about the turn of the century, and having made the observation did something about it by gathering together a group of students who spent much time and energy developing the subject.

You will find no subject so verbose and you will find no subject which enjoys such a wide variation of opinion as that of orthodontic education. The young man now in 1938 who is ambitious to undertake seriously the study of orthodontics, upon inquiring as to the proper approach and as to the possible available instruction open to him, soon becomes baffled and confused and finds that opinion upon this subject is as varied as is the opinion of a half dozen labor leaders about the wages and hours bill.

Ask the average conscientious practitioner of orthodontics of wide experience as to what is the most direct, efficient and practicable route to develop skill in this particular department of practice, and he will, in all probability, answer at first by saying, "I do not know." He may then add, "If you can arrange to spend about three months in Doctor Experience's office, then about two months' additional time with Doctor So-and-So in Such-and-Such a city,

and, at the same time take a practical course at a university, this will, no doubt, be as direct a route as possible to follow at the present time in order to secure orthodontic training."

If you ask Doctor Experience about the various private courses given by private practitioners in officers and in privately conducted classes, he will no doubt answer, first, by saying that there is one and only one reason for these courses to exist and that reason is plainly exemplified in the well-known epigram that where there is a demand somebody will create the supply; also that there are certain highly specialized orthodontic techniques which can be secured and are available from no other sources than through private tutoring from individuals engaged in private practice. Ask him about the various university extension courses in orthodontics, and he will probably say, "Very well, if you are able to afford the time and money and are able to select a good one in which the clinic and the technical courses are conducted by experienced and skillful orthodontists." To this, he no doubt would add the observation that almost all dental schools have a difficult problem to solve, however, when they approach the orthodontic postgraduate work because dental schools for the most part are not endowed or equipped for postgraduate and research work, and that the instructors for the most part must practice privately for their major occupation in order to make a livelihood, and this makes graduate instruction difficult so far as attracting experienced and outstanding teachers and leaders in the subject.

So it seems logical to assume that most of the criticism directed at orthodontists leads to the doorstep of the complexities and paradoxes of orthodontic education. The practice has created for itself within the short space of a few years an enviable name because it has numbered among its workers men of enthusiasm and energy and with a fraternal allegiance to their subject. Now in the present day, when students become ambitious to take up the work and begin to seek information, they find orthodontists themselves at a loss to tell them how to go about preparing for practice; they too often misinterpret the orthodontist's honest dilemma concerning the difficulties of orthodontic education to be personal intolerance and selfishness on his part and an effort to discourage orthodontic training.

It is to be remembered there are some paradoxical situations. In this connection it should be recalled that as long as a university grants a degree to a graduate dentist qualifying him legally to practice orthodontics when at the same time the university knows he is unskilled and untrained to practice the subject, as long as a state board grants a license to a dentist to practice orthodontics when it makes little inquiry as to the candidate's ability to practice the subject, as long as there is such confusion in the practical formal educational set-up to train young men in the modern methods of orthodontic practice, just so long will the present generation of orthodontists be told that they are too critical of the short-cut, "catch-as-catch-can" approaches to practice.

Let it be hoped there will arise from the ashes of all this misunderstanding and discord a university, amply endowed with the necessary funds and

staffed with sufficient expert, skillful orthodontists of talent and experience to solve this educational problem and thereby save orthodontics from its present rôle as the educational "step child" of dentistry. Not until then will workers cease to be known as "Angle men," "Jackson men," "Dewey men," etc., ad infinitum; not until then will the doorstep to orthodontic practice cease to be an experimental educational problem of dentistry because it is a difficult subject to teach properly and requires time to reach its perfection. Orthodontic instruction now awaits two things: first, a teacher with a vision and following, one of practical ability who enjoys the full confidence of the orthodontic fraternity; second, an endowment with which to carry out his plans with the entire cooperation of orthodontists and in conjunction with a great university which will teach what is known, in a practical way, about the subject as well as the theoretic and collateral branches.

H. C. P.

Leigh C. Fairbank to Be First Brigadier-General of the Dental Corps, U. S. Army

Leigh C. Fairbank, D.D.S., was selected the first brigadier-general of the Dental Corps of the U. S. Army under the new dental legislation by the President of the United States on February 15, 1938, and the nomination was confirmed by the senate on March 4. The new brigadier-general of the Dental Corps took the oath of office on March 11 this year.

Brigadier-General Fairbank has been well known to the orthodontic fraternity for the last twenty years. He studied orthodontics under the late Martin Dewey, and later took various postgraduate courses in the subject. For many years he has devoted a great deal of his time to orthodontic practice in the various army posts of the United States.

General Fairbank will take with him into his new work the best wishes and congratulations of a host of orthodontists throughout the world with whom he has enjoyed a wide acquaintance and mutual professional interest for many years.

NOTE.—The appointment having been made so near the time of going to press, more definite information and detail will appear in the Journal at a later date.

News and Notes

American Association of Orthodontists

The thirty-sixth annual meeting of the American Association of Orthodontists will be held in Los Angeles July 11 to 14. This meeting will be held at the Roosevelt Hotel, which is located within the glamorous center of Hollywood, with its many interests for visitors from other states.

Dr. James D. McCoy, President
3839 Wilshire Blvd.
Los Angeles, Calif.

Dr. Claude R. Wood, Sec'y-Treas.
608 Medical Arts Bldg.
Knoxville, Tenn.

American Board of Orthodontia

A meeting of the American Board of Orthodontia will be held in Los Angeles, July 8, 1938.

Orthodontists who desire to qualify for certificates from the Board should secure the necessary application blanks from the secretary. The applications must be returned to the secretary, together with any other required credentials, at least sixty days prior to the date of examination. Applications filed at the time of the Board meeting will have preliminary consideration, so that the applicant may be advised of the work required for his subsequent examination.

Attention is called to the following resolutions adopted by the Board: Any person desiring to make application to the Board for a certificate must have been in the exclusive practice of orthodontics for a period of not less than five years or an equivalent to be determined by the Board and based upon the following conditions:

1. He must be an instructor in orthodontics in a school satisfactory to the Board.

2. He must be an associate in the office of an orthodontist whose standing is satisfactory to the Board.

3. It is definitely to be understood that any person at the time of making application for a certificate shall be in the exclusive practice of orthodontics in his own name.

For further information please address

Charles R. Baker, Secretary,
636 Church Street,
Evanston, Ill.

Central Society of Orthodontists

On February 16 under the leadership of a committee headed by Dr. J. W. Ford of Chicago, the Central Society of Orthodontists to be a component society of the American Association of Orthodontists was organized. The membership of the organization will be made up of men from the states of Illinois, Wisconsin, Minnesota, Nebraska, Missouri, and Iowa, as well as those in any bordering states not already affiliated with a sectional society. Application for membership may be sent to the secretary.

Officers elected at the meeting are:

President: Dr. Max Ernst, St. Paul, Minn.
President Elect: Dr. Harold J. Noyes, Chicago, Ill.
Vice President: Dr. Arthur C. Rohde, Milwaukee, Wis.
Secretary-Treasurer: Dr. L. B. Higley, Iowa City.
Member of Executive Committee: Dr. O. W. Brandhorst, St. Louis.
Delegate to the American Association of Orthodontists: Dr. B. E. Lischer, St. Louis.

Dr. L. B. Higley, Secretary,
714 Iowa Avenue,
Iowa City, Iowa.

North Atlantic Orthodontic Society

The eighth semi-annual meeting of the North Atlantic Orthodontic Society will be held at the Hotel Pennsylvania, New York City, on Wednesday afternoon and evening, April 27, starting at 1:30 P.M. All ethical members of the dental and medical professions are cordially invited.

Dr. E. A. Lusterman, Secretary,
1 Nevins Street,
Brooklyn, N. Y.

European Orthodontilogical Society

The annual meeting of the Society will be held in London July 14 and 15 under the presidency of Dr. Harold Chapman.

National Dental Poster Contest Prizes

Loving cups will be awarded the fifteen winners of the National Poster Contest at St. Louis. The American Dental Association will also award an Encylopedia Britannica to each of the five schools represented by the children winning first place in each division.

Senior Encyclopedias to the winning vocational school.
Senior Encyclopedias to the winning senior high school.
Junior Encyclopedias to the winning junior high school.
Junior Encyclopedias to the winning elementary school.
Junior Encyclopedias to the winning rural school.

In addition, the American Dental Association will furnish a 7 by 9 inch certificate of award to each of the fifteen winners in each component poster contest.

LON W. MORREY, Chairman of National
Poster Contest Committee,
American Dental Association,
212 E. Superior Street,
Chicago, Ill.

Dental Society of State of New York

The seventieth annual meeting of the Society will take place May 10-13 at the Hotel Syracuse, Syracuse, New York.

DR. EDWIN I. HARRINGTON, President
Woolworth Building
Watertown, N. Y.

North Carolina Dental Society

The sixty-fourth annual meeting of the North Carolina Dental Society will be held at the Robert E. Lee Hotel in Winston-Salem, N. C., May 2-4, 1938. All members of the American Dental Association are cordially invited to attend.

FRANK O. ALFORD, Sec.-Treas.,
1109 First National Bank Bldg.,
Charlotte, N. C.

Cleveland Dental Society

The Seventh Annual Two-Day Clinic Meeting of the Cleveland Dental Society will be held April 4 and 5 at the Statler Hotel, Cleveland, Ohio.

DR. JOHN I. SLOAN, General Chairman,
Rose Building,
Cleveland, Ohio.

American Dental Assistants Association

The fourteenth annual session of the American Dental Assistants Association will be held at St. Louis, October 24-28. For further information, address

LUCILE S. HODGE, Secretary,
401 Medical Arts Bldg.,
Knoxville, Tenn.

American Dental Hygienists' Association

The American Dental Hygienists' Association will meet October 24-28 at St. Louis.

DAISY M. BELL, Secretary,
974 Amherst Street,
Buffalo, N. Y.

World Federation of Education Associations

The proceedings of the Seventh Biennial Conference, Health Section, World Federation of Education Associations, held in Japan, August, 1937, are now available. The thirty-seven papers, prepared by representatives of seventeen countries, deal with the broad phases of Health Education, Health Services, and Physical Education, with particular emphasis on rural problems.

Mouth health as an integral part of the school health program of many countries is presented with the views of dentists, dental hygienists, and physicians. The report, of 258 pages, may be ordered from the:

Health Section Secretariat,
World Federation of Education Associations,
200 Fifth Avenue,
New York, N. Y.

Pacific Coast Society of Orthodontists

Northern Section

The first all day meeting of the Northern Section was held December 14, 1937. Albert J. Bowles, M.D., presented a paper, with lantern slides, on "Endocrinology and Its Relationship to Orthodontia." Case reports were given by Dr. Emery Fraser, Dr. Frank Wannamaker, Dr. George Barker, Dr. Milton Fisher, Dr. Harry Moore, Dr. E. Allen Bishop, and Dr. Paul D. Lewis. A motion picture entitled "The Road to Health and Happiness" was shown by Dr. David Hill of Salem, Oregon.

Southern Section

The regular meeting of the Southern Section was held in Los Angeles on December 10, 1937. The program dealt with the question of the relation of abnormal functional and pressure habits to dental anomalies. Dr. Aldys Gray presented a paper on "External Pressure Habits"; Dr. Jesse Lynn discussed the paper with particular reference to sleeping, leaning and posture habits. Dr. Herbert Muehnic showed moving picture illustrations of abnormal function and pernicious tongue habits.

The Horace Wells Anesthesia Society

The Horace Wells Anesthesia Society brings the activities of the fiscal year to a close on April 11 at 9 P.M., at the Hotel St. George in Brooklyn.

Dr. E. A. Rovenstine will present an address on the "Evaluation of Ambulatory Patients for Dental Anesthesia in Office Practice." Dr. Rovenstine is professor of anesthesia at New

York University College of Dentistry; New York University College of Medicine; and director of anesthesia at Bellevue Hospital. Question from the floor will follow. At the end of the meeting there will be a demonstration of anesthesia apparatus.

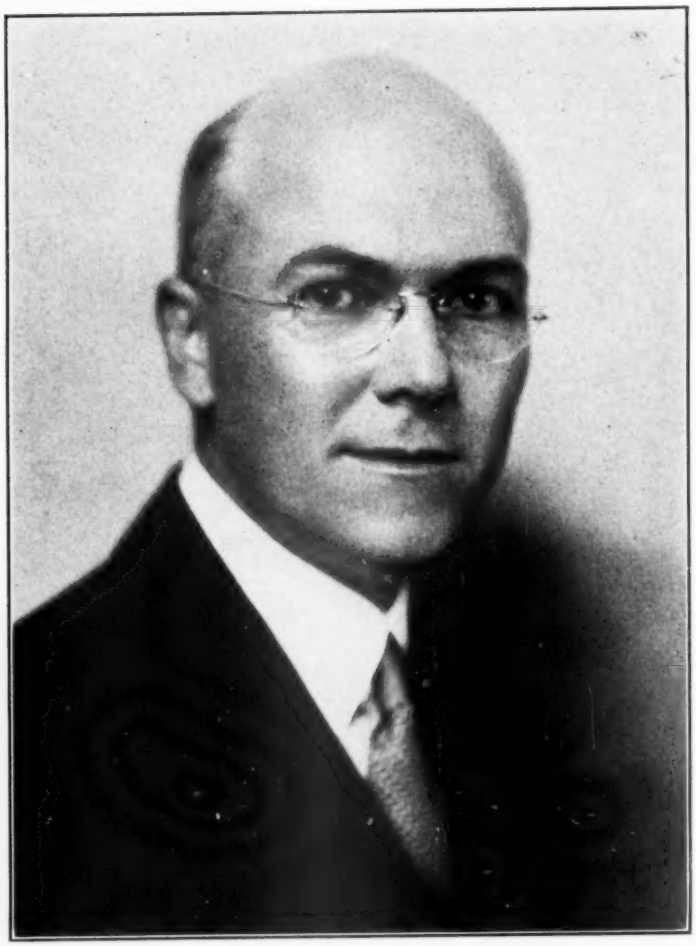
Dr. M. Lee Garland, Secretary,
781 44th Street,
Brooklyn, N. Y.

Note of Interest

Dr. Alexander L. Ungar announces the opening of an office at 75 State Street, Albany, N. Y. Dr. Ungar's office in New York City is at 211 Central Park West. Practice limited to orthodontics.

Erratum

The late Dr. Frederick Paine Wells was a graduate of the Dewey School of Orthodontia, not of the International School of Orthodontia as was stated in the February issue of the Journal, page 197.



DR. JAMES DAVID MCCOY, PRESIDENT OF THE AMERICAN ASSOCIATION OF ORTHODONTISTS